VOL. 7, NO. 23
December 15, 1982

Energy Research Abstracts

ABSTRACTS 60711-62568

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830. Telephone (615) 576-1303; (FTS) 626-1303.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $4.50, foreign $5.65 per copy; annual cumulative index, domestic $7.00, foreign $8.75 per copy. The annual subscription price is $48.00 for domestic subscribers and $60.00 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $150.00 for domestic subscribers and $187.50 for foreign subscribers. A single issue costs $6.50 (domestic) or $8.15 (foreign).

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A semimonthly current awareness bulletin covering all aspects of the nuclear fuel cycle, both front end and back end. Available as PB82-913400.

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Radioactive Waste Management (RWM)

A semimonthly current awareness bulletin covering the following management aspects: transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers. Available as PB82-902900.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the Energy Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the Energy Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, the Center places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory energy analysis, and policy-related areas. To accomplish this mission, the Center builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to the Center's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of the Center's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Center has developed and maintains systems to record and communicate energy-related research-in-progress information, to catalog official DOE issue-and-policy documents, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications. The Center also maintains a full-scale publishing capability to serve special publication needs of the Department. To effectively manage DOE's technical information resources, the Center's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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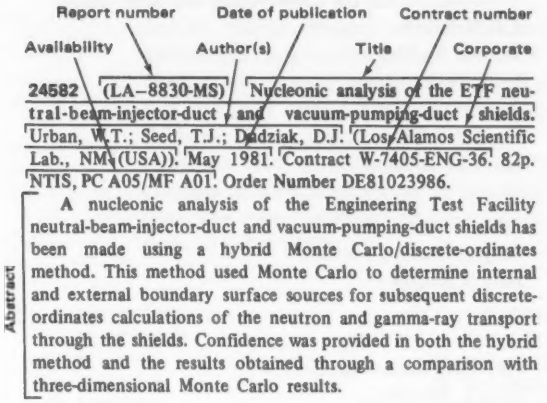
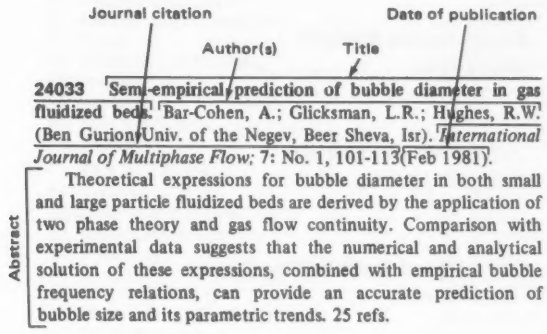
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Contract number
Availability
Author(s)
Title
Corporate
24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.
Abstract
A nucleonic analysis of the Engineering Test Facility neutral-beam-injector-duct and vacuum-pumping-duct shields has been made using a hybrid Monte Carlo/discrete-ordinates method. This method used Monte Carlo to determine internal and external boundary surface sources for subsequent discrete-ordinates calculations of the neutron and gamma-ray transport through the shields. Confidence was provided in both the hybrid method and the results obtained through a comparison with three-dimensional Monte Carlo results.


Journal citation
Date of publication
Author(s)
Title
24033 Semi-empirical prediction of bubble diameter in gas fluidized beds. Bar-Cohen, A.; Glicksman, L.R.; Hughes, R.W. (Ben Gurion Univ. of the Negev, Beer Sheva, Isr). International Journal of Multiphase Flow; 7: No. 1, 101-113 (Feb 1981).
Abstract
Theoretical expressions for bubble diameter in both small and large particle fluidized beds are derived by the application of two phase theory and gas flow continuity. Comparison with experimental data suggests that the numerical and analytical solution of these expressions, combined with empirical bubble frequency relations, can provide an accurate prediction of bubble size and its parametric trends. 25 refs.

• INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. **(Los Alamos Scientific Lab., NM (USA)).** May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (LA–8830-MS)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Bar-Cohen, A., Semi-empirical prediction of bubble diameter in gas fluidized beds, 7:24033
Dudziak, D.J., *See* Urban, W.T., 6:24582
Glicksman, L.R., *See* Bar-Cohen, A., 7:24033
Hughes, R.W., *See* Bar-Cohen, A., 7:24033
Seed, T.J., *See* Urban, W.T., 6:24582
Urban, W.T., Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (LA–8830-MS)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles or informative phrases, or both, specific to these entries are arranged alphabetically under the entries.

TOKAMAK ETF
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Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (LA–8830-MS)
Neutron Transport
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (LA–8830-MS)

• Contract Number Index

DOE technical literature is indexed using contract numbers under which the literature was produced. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos National Lab., NM (USA)**	
	6:24582	LA–8830-MS

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order Number-Report Number Correlation is included for convenience.

LA–		
8830-MS	6:24582	NTIS, PC A05/MF A01. Order Number DE81023986, Distribution Category STD-20d

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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SUBJECT CONTENTS (ALPHABETICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS
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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 60821, 61672

60711 APS Study Group on Coal Utilization and Synthetic Fuel Production: introduction. *Reviews of Modern Physics;* **53**: No. 4, S9-S14(Oct 1981).

The study reported here is the most recent one of a series initiated and organized by the American Physical Society through its Panel on Public Affairs. At the outset it was decided to aim at selectivity - to identify and treat a limited number of important technical issues in some depth, rather than to aim at a comprehensive treatment. The areas selected were: Physical (i.e. Pore) Structure of Coal, Analytical Techniques, Instrumentation and Control, Modeling and Flow Theory, Materials Problems, Size-dependent Phenomena (i.e. size reduction of coal and coal/fluid interactions), and Catalysis. The bulk of this report consists of these research assessments in these areas which delineate the practically important and scientifically significant opportunities for physicists. Our principal recommendations include both recommendations for specific priority research and for institutional arrangements necessary to get the most out of that research, specifically: (1) establishment of a program for development and testing of theoretical models and process control techniques in coordination with requisite work on development of instrumentation; and (2) provision for a bank of well characterized coal samples.

0104 Processing

REFER ALSO TO CITATION(S) 60769, 60773, 60773, 60774, 60774, 60783, 60785, 60821, 60833, 60841, 61134, 61242, 61850

60712 (ANL/FE—82-7) International energy technology assessment: status of materials for coal gasification. Gehl, S.M.; Natesan, K. (Argonne National Lab., IL (USA)). Nov 1981. Contract W-31-109-ENG-38. 52p. NTIS, PC A04/MF A01. Order Number DE82021267.

The difficulties in obtaining information on foreign technologies lead to serious limitations on the level of detail in the technology assessment. The extensive commercial operating experience with gasifiers of the Lurgi and Koppers-Totzek varieties has no counterpart in the US. This situation translates into a great deal of engineering data on the operating envelopes of ceramics and alloys. This type of information is crucial to the operation of a Lurgi gasifier, and some of it is translatable to other types of gasifiers. However, the emerging technologies envisaged for the US gasification programs and the developmental foreign programs require a much higher level of materials technology than is represented in current commercial practice. In the area of new materials for coal gasification applications, we find a rough equivalence between the levels of US and foreign technologies. In fact, our assessment indicates that the US holds a lead in the development and testing of alloys for high-temperature service in corrosive environments. However, a few significant technical developments have occurred in foreign countries without comparable domestic advances. These include the pilot-plant experience on refractories for slagging gasifiers (Shell-Koppers, Texaco, and BGC); the development of corrosion-resistant alloys based on refractory metals (BGC); and the long-term high-temperature creep tests (Karslruhe). Foreign organizations can almost always present the disclosure of large amounts of detailed technical information, if they so desire. Information-exchange agreements with the foreign organizations identified in this report may prove fruitful in providing the type of information needed for the US program.

60713 (DOE/BC/13407—1) Gaseous detonation fraction of porous materials for enhanced fossil-fuel utilization and recovery. Kauffman, C.W.; Yan, C.; Nicholls, J.A. (Michigan Univ., Ann Arbor (USA). Dept. of Aerospace Engineering). Aug 1982. Contract FG19-80BC13407. 107p. NTIS, PC A06/MF A01. Order Number DE82021661.

This study was directed to the feasibility of using gaseous detonation to effect the increase in porosity. Towards that end, a heavy walled pipe (1.829 m long, 0.124 m I.D., and 0.168 m O.D.) was filled with solid spheres. In separate experiments, steel spheres of 19.05 mm and 38.1 mm and ceramic spheres of 38.1 mm were used. The gaseous combustible mixtures tested included hydrogen, methane, and propane, all with oxygen as the oxidizer. A range of elevated initial pressures and mixture equivalence ratios were tested. In each case, the variation of wave velocity and pressure along the tube, as well as the strain (stress) on the outside of the tube, were determined. The spheres caused the detonation velocity to be lower than the theoretical Chapman-Jouguet (CJ) velocity, which would be expected in an open tube of that size. Increase of the initial pressure, diameter of the spheres, and equivalence ratio from lean towards stoichiometric resulted in an increase in detonation velocity (and hence pressure and stress). The material of the sphere had a slight effect; the steel spheres resulted in the higher velocities. The measured velocities and pressures were compared with the calculated CJ values. An approximate one-dimensional steady analytical model, which included energy losses in the reaction zone, was developed. This expression was used to calculate the critical condition wherein the detonation would no longer propagate through the packed bed, thus predicting the minimum sphere diameter required for quenching. Finally, some experiments were conducted wherein a large container was filled with coal, sprayed with water, and allowed to freeze outside. Propane-oxygen was blown through the pile and then detonated. Considerable fracturing was experienced.

60714 (DOE/CH/10047—3) Low-Btu coal-gasification-process design report for Combustion Engineering/Gulf States Utilities coal-gasification demonstration plant. Andrus, H.E.; Rebula, E.; Thibeault, P.R.; Koucky, R.W. (Combustion Engineering, Inc., Windsor, CT (USA). Power Systems Group). Jun 1982. Contract AC02-80CH10047. 427p. NTIS, PC A19/MF A01. Order Number DE82021055.

This report describes a coal gasification demonstration plant that was designed to retrofit an existing steam boiler. The design uses Combustion Engineering's air blown, atmospheric pressure, entrained flow coal gasification process to produce low-Btu gas and steam for Gulf States Utilities Nelson No. 3 boiler which is rated at a nominal 150 MW of electrical power. Following the retrofit, the boiler, originally designed to fire natural gas or No. 2 oil, will be able to achieve full load power output on natural gas, No. 2 oil, or low-Btu gas. The gasifier and the boiler are integrated, in that the steam generated in the gasifier is combined with steam from the boiler to produce full load. The original contract called for a complete process and mechanical design of the gasification plant. However, the contract was curtailed after the process design was completed, but before the mechanical design was started. Based on the well defined process, but limited mechanical design, a preliminary cost estimate for the installation was completed.

60715 (DOE/CH/10047—4) Fault tree analysis report for Combustion Engineering, Inc. coal-gasification process-development unit in support of the Combustion Engineering/Gulf States Utilities Coal-Gasification Demonstration Plant. Powers, G.J.; Lapp, S.A. (Design Sciences, Inc., Sewickley, PA (USA)). Jun 1982. Contract AC02-80CH10047. 156p. NTIS, PC A08/MF A01. Order Number DE82020754.

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While work on the PDU safety tree was in progress, C-E's contract with the DOE was curtailed. Under the reduced work scope, safety and reliability fault trees for the PDU were constructed; however, the verification and analysis of these trees could not be completed. In addition, no work was done on the risk and reliability assessment of the demonstration plant design. Detailed fault trees with probability and failure rate calculations were generated for the events: (1) Fatality due to Explosion, Fire, Toxic Release or Asphyxiation at the PDU Coal Gasification Process; and (2) Loss of Availability of the PDU. The fault trees for the PDU were synthesized by Design Sciences, Inc. The trees were then subjected to multiple reviews by Combustion Engineering. The steps involved in hazard identification and evaluation, fault tree generation, probability assessment, and design alteration are presented in the main body of this report. The fault trees, cut sets, failure rate data and unavailability calculations are included as attachments to this report. Although both safety and reliability trees have been constructed for the PDU, the verification and analysis of these trees were not completed as a result of the curtailment of the demonstration plant project. Certain items not completed for the PDU risk and reliability assessment are listed.

60716 **(DOE/ET/10060—84-Vol.2) Cresap Test Facility. Final report, September 1, 1977-September 30, 1979.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Liquefied Coal Development Corp., Cresap, WV (USA)). Dec 1981. Contract AC01-76ET10060. 212p. NTIS, PC A10/MF A01. Order Number DE82020063.

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This is the final technical report on the work performed at the Cresap Test Facility, Cresap, West Virginia by Fluor Engineers and Constructors, Inc., and Liquefied Coal Development Corporation for the Department of Energy under Contract EX-76-C-01-1517. The report describes and summarizes the results of all work performed in operating the facility and conducting mechanical component testing. A previously issued report, Interim Report No. 1, describes the engineering and construction activities for refurbishing and expanding the Cresap Test Facility during the period from May 1974 through September 1977. This report is presented in two volumes. Volume I presents descriptions and data for: operating history; test program; process discussion and accomplishments; computer utilization; health, safety, security and environmental protection; and a suggestion for future operations; Volume II contains: plant status after shutdown; a facility maintenance plan; data available for plant recommissioning; available operating manuals; and mechanical diagrams, process facilities.

60717 **(DOE/ET/10131—T7) Upgrading of coal liquids. Annual interim report, January 31, 1980-September 30, 1981.** Gatsis, J.G.; Weiszmann, J.A. (UOP, Inc., Des Plaines, IL (USA)). Jan 1982. Contract AC22-77ET10131. 417p. (FE—2566-50). NTIS, PC A18/MF A01. Order Number DE82016972.

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The coal liquids were stable while the petroleum crude oils showed some measure of instability. Instability in the coal liquid/petroleum crude oil blends was accounted for by the instability of the petroleum curde oil. Blending of the coal liquids/petroleum crude oil revealed no adverse effects in co-processing. Studies were undertaken to measure the economic impact on a typical Gulf CCoast refinery of introducing varying quantities of H-Coal liquid to replace equivalent amounts of imported crude oil. The use of both raw and hydrotreated coal liquids was investigated. When even small amounts of raw coal liquid were introduced, the need for a new naphta hydrotreater became apparet because of the nitrogen and olefins present in the naphtha. As greater portions of raw coal liquid were added, other specified limitations were reached. When imported crude oil was replaced by hydrotreated H-Coal liquid, fractionation limitations were essentially the same as for the raw coal liquids cases. The processing of additional quantities of coal liquids (raw or hydrotreated), replacing imported crude, had no great effect on product slate or refinery economics. The derived maximum values which a refiner could afford to pay for raw or hydrotreated coal liquid and still maintain his profit were nearly the same in each cast. Intuitively, however, one would assume that hydrotreated coal liquid would cost more. These conclusions are subject to confirmation by definitive studies of the stability of fresh raw coal liquid and its compatibility with crude oil.

60718 **(DOE/ET/10137—T4) Gasification of residual materials from coal liquefaction: Type-III extended pilot-plant evaluation of a molten Exxon donor solvent (EDS) liquefaction process residue from Illinois No. 6 coal.** Robin, A.M.; Yang, H.L. (Texaco, Inc., Montebello, CA (USA). Montebello Research Lab.). Aug 1982. Contract AC01-76ET10137. 67p. (FE—2247-30). NTIS, PC A04/MF A01. Order Number DE82019929.

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A Type III Extended Pilot Plant Evaluation of Exxon EDS Vacuum Residue, which was obtained from the liquefaction of Illinois No. 6 coal at the Exxon Baytown Texas coal liquefaction pilot plant, was successfully completed at Texaco's Montebello Research Laboratory. A total of forty-four tons of EDS residue was gasified during five runs which were carried out at 1200 psig in the Texaco pilot plant residue gasifier. The solvent dilution levels, the steam-to-residue ratio and the oxygen-to-residue ratio were varied to determine optimum operating conditions. A total of 97 hours of on-stream time was accumulated. The longest continuous run was 28 hours. This work was authorized by DOE Delivery Order Number 6 under DOE contract DEAC01-76ET10137. It is part of a continuing project to evaluate residual materials from various DOE sponsored coal liquefaction projects to determine their suitability for conversion to hydrogen in one of the Texaco gasification processes.

60719 **(DOE/ET/10639—T1) Particulate removal at high temperature and pressure by self-agglomeration in a cyclone. Final technical report, September 1, 1977-December 31, 1979.** Tsao, K.C.; Bradley, J.; Yung, K.T.; Jen, J.O. (Wisconsin Univ., Milwaukee (USA). Coll. of Engineering and Applied Science). 1979. Contract FG01-77ET10639. 111p. NTIS, PC A06/MF A01. Order Number DE82011170.

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An analytical and experimental study on a high temperature agglomerating cyclone was carried out to determine the cyclone collection efficiency as a function of dust loading and its operating parameters. Experimental data are presented and indicate that the high temperature cyclone collection efficiency based on the ash mass collected in the hopper varies from 89 to 94%. Microscopic examination of collected particles on the filter paper at cyclone exit shows that the collected particles are mostly of 2m diameter size. Mathematical modeling indicates that the collection efficiencies of submicron particulates are increased from 19.81% to 36.6% and from 75 to 89.2% for 2m and 5m size particles respectively. Experimental data agree qualitatively with the computed value. Agglomeration mechanism modeling indicated that the particle kinetic energy before collision, the thickness of molten surface layer, the viscosity and surface tension of pseudo-molten ash are the principal factors affecting the agglomeration process.

60720 **(DOE/ET/10666—T10) Valve development for coal-gasification plants. Phase II. Quarterly technical status report, January-June 1982.** Bellezza, D. (Fairchild Industries, Inc., Manhattan Beach, CA (USA)). 1982. Contract AC21-76ET10666. 10p. (FE—2356-154). NTIS, PC A02/MF A01. Order Number DE82018080.

Phase II, whose scope of work was revised effective July 1, 1982 now involves the detail design, fabrication and acceptance testing of four prototype valves which are representative of the four different valve types. The four completed valves, each 8 inches in diameter, will be delivered to the Morgantown Energy Technology Center for prototype evaluation testing. Thus far, two Task II valves have been delivered to METC. Work continued on assembly of the first Task III valve plus development of alternative stuffing box packing and seals. Excessive seat leakage on the first Task III valve was experienced. At that point work was suspended in favor of work to support test of the FCSC furnished Task II valves at METC. All further work was suspended due to limits of funding.

60721 **(DOE/ET/11338—1216) Role of C-CO_2 in gasification of coal and char. Final report, 15 August 1978-15 November 1981.** Sears, J.T.; Wen, C.Y. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). 1981. Contract AC21-78ET11338. 124p. NTIS, PC A06/MF A01. Order Number DE82016392.

The objectives of the project were to investigate coal-char gasification reactions with CO_2, H_2O and other gases, to examine fluid dynamics of char present in a fluidized bed, and to develop a computer model of the fluid-bed gasification which can incorporate such information. To these ends a unique high pressure/temperature thermogravimetric analysis instrument, a pressurized 30 cm-dia. fluid bed, and a high-temperature 13 cm fluid bed were constructed. Coal pyrolysis and char reactions were examined at temperatures to 1600°C and pressure to 28 atm. Extent of pyrolysis was shown to depend on particle size and pressure, and in three stages on temperature. Char properties were determined, including diffusion coefficients of CO_2 in char and surface areas. Char reactivity does not strongly depend on pressure in the range 1 to 28 atm. Diffusion limits are strongly present above 1000°C. Inhibition by CO and H_2 increase rapidly with pressure. Elutriation of particles in a hot bed can be determined from low-temperature results if compared at the same value of excess fluid velocity above minimum fluidization. Bubble size and numbers change slightly with pressure. Fluid bed gasificaton can be modeled successfully, and a basic model is presented here.

60722 **(DOE/ET/14880—01) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. First quarterly report, May 15, 1979-August 15, 1979.** Gates, B.C.; Katzer, J.R.; Kwart, H.; Olson, J.H.; Schuit, G.C.A.; Stiles, A.B. (Delaware Univ., Newark (USA). Center for Catalytic Science and Technology; Gulf Research and Development Co., Pittsburgh, PA (USA)). 30 Sep 1980. Contract AC22-79ET14880. 101p. NTIS, PC A05/MF A01. Order Number DE82019756.

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An asphaltene-containing SRC II coal liquid from the Ft. Lewis demonstration plant has been selected for study of catalytic hydroprocessing reactions. Analytical separation of the liquid by liquid chromatography will be used to produce nine distinct fractions. These will be prepared from 1 kg of coal liquid and used individually as feeds to high-pressure flow microreactors. Hydroprocessing of polynuclear aromatic hydrocarbons under industrially relevant conditions has shown that they are much more reactive than benzene. The reaction networks involve reversible hydrogenation and isomerization, and significant concentrations of hydroaromatic (hydrogen-donor) species are attainable under practical conditions. Scanning electron microscopy combined with catalytic activity measurements (in hydroprocessing of dibenzothiophene and of quinoline) were used to characterize deactivated and regenerated Ni-Mo/Al_2O_3 catalysts (aged in the hydroprocessing of coal-derived liquids). EDAX results determined chemical composition of the catalyst and the deposited mineral crust. The hydroprocessing results indicate that regeneration of the catalysts can recover much of the activity lost as a result of coke formation.

60723 **(DOE/ET/14880—02) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. Second quarterly report, August 15, 1979-November 15, 1979.** Gates, B.C.; Katzer, J.R.; Kwart, H.; Petrakis, L.; Ruberto, R.; Schuit, G.C.A.; Stiles, A.B. (Delaware Univ., Newark (USA). Center for Catalytic Science and Technology; Gulf Research and Development Co., Pittsburgh, PA (USA)). 20 Oct 1980. Contract AC22-79ET14880. 26p. NTIS, PC A03/MF A01. Order Number DE82019757.

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An asphaltene-containing SRC-II coal liquid derived from Powhatan No. 5 mine coal and produced in the Ft. Lewis demonstration plant has been selected for study of catalytic hydroprocessing reactions. Analytical separation by liquid chromatography is being carried out to produce nine distinct fractions from 1 kg of coal liquid. These fractions will be used as feeds to high-pressure catalytic flow microreactors. Hydroprocessing of polynuclear aromatic hydrocarbons under industrially relevant conditions has shown that these are much more reactive than benzene. The reaction networks involve reversible hydrogenation and isomerization, and significant concentrations of hydroaromatic (hydrogen-donor) species are attainable under practical conditions. Hydroprocessing of solutions containing the following combinations of compounds has also been studied: quinoline/indole, quinoline/indole/dibenzothiophene, and quinoline/indole/naphthalene. Four of the types of compounds, or potential lumps, in coal-derived liquids are basic nitrogen, nonbasic nitrogen, sulfur, and aromatic compounds. It is desired to determine how these compounds interact and compete with each other in hydroprocessing and how these interactions depend on hydrogen partial pressure. Four model compounds, quinoline, indole, dibenzothiophene, and naphthalene, have been selected to represent compounds in each group. These compounds, in different proportions with hydrogen, were allowed to react in a batch autoclave reactor.

60724 **(DOE/ET/14880—03) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. Third quarterly report, November 15, 1979-February 15, 1980.** Gates, B.C.; Katzer, J.R.; Kwart, H.; Petrakis, L.; Ruberto, R.; Schuit, G.C.A.; Stiles, A.B. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering; Gulf Research and Development Co., Pittsburgh, PA (USA)). 1 Nov 1980. Contract AC22-79ET14880. 67p. NTIS, PC A04/MF A01. Order Number DE82019758.

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An asphaltene-containing SRC-II coal liquid derived from Powhatan No. 5 mine coal and produced in the Ft. Lewis demonstration plant has been selected for study of catalytic hydroprocessing reactions. Analytical separation by liquid chromatography is being carried out to produce nine distinct fractions from 1 kg of coal liquid. These fractions will be used as feeds to high-pressure catalytic flow microreactors. Hydroprocessing of polynuclear aromatic hydrocarbons under industrially relevant conditions has shown that these are much more reactive than benzene. The reaction networks involve reversible hydrogenation and isomerization, and significant concentrations of hydroaromatic (hydrogen-donor) species are attainable under practical conditions. Hydroprocessing of solutions containing the following combinations of compounds has also been studied: quinoline/indole, quinoline/indole/dibenzothiophene, and quinoline/indole/naphthalene. The kinetics of biphenyl hydrogenation catalyzed by sulfide Co-Mo/γ-Al_2O_3 has been determined quantitatively at 70 to 200 atm and 300 to 375°C. The effects of reversibility of the reaction and inhibition by biphenyl, H_2S, and H_2 are summarized in a rate equation of the Langmuir-Hinshelwood type. Scanning electron microscopy combined with catalytic activity measurements was used to characterize deactivated and regenerated Ni-Mo-Al_2O_3 catalysts. EDAX results determined chemical composition of the catalyst and the deposited mineral crust. The results indicate that regeneration of the catalysts can recover much of the activity lost as a result of coke formation.

60725 **(DOE/ET/14880—04) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. Fourth quarterly report, February 15, 1980-May 15, 1980.** Petrakis, L.; Ruberto, R.; Gates, B.C.; Katzer, J.R.; Kwart, H.; Schuit, G.C.A.; Stiles, A.B. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering; Gulf Research and Development Co., Pittsburgh, PA (USA)). 10 Nov 1980. Contract AC22-79ET14880. 242p. NTIS, PC A11/MF A01. Order Number DE82019759.

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An asphaltene-containing SRC-II coal liquid derived from Powhatan No. 5 mine coal and produced in the Ft. Lewis demonstration plant has been selected for study of catalytic hydroprocessing reactions. Analytical separation by liquid chromatography has been carried out to produce nine distinct fractions from 1 kg of coal liquid. These have been further separated into compound classes and characterized in detail by elemental analysis, mass spectrometry, NMR, and infrared spectroscopy. Compounds typical of each fraction (except asphaltenes) have been designated. Hydroprocessing of polynuclear aromatic hydrocarbons under industrially relevant conditions has shown that these are much more reactive than benzene. The reaction networks involve reversible hydrogenation and isomerization, and significant concentrations of hydroaromatic (hydrogen-donor) species are attainable under practical conditions. Hydroprocessing of solutions containing the following com-

binations of compounds has also been studied: quinoline/indole, quinoline/indole/dibenzothiophene, and quinoline/indole/naphthalene. Scanning electron microscopy combined with catalytic activity measurements was used to characterize deactivated and regenerated Ni-Mo-Al_2O_3 catalysts. EDAX results determined chemical composition of the catalyst and the deposited mineral crust. The results indicate that regeneration of the catalysts can recover much of the activity lost as a result of coke formation.

60726 **(DOE/ET/14880—05) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. Fifth quarterly report, May 15, 1980-August 15, 1980.** Gates, B.C.; Katzer, J.R.; Kwart, H.; Olson, J.H.; Schuit, G.C.A.; Stiles, A.B.; Petrakis, L. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering; Gulf Research and Development Co., Pittsburgh, PA (USA)). 15 Nov 1980. Contract AC22-79ET14880. 58p. NTIS, PC A04/MF A01. Order Number DE82019760.

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An asphaltene-containing SRC-II coal liquid derived from Powhatan No. 5 mine coal and produced in the Ft. Lewis demonstration plant has been selected for study of catalytic hydroprocessing reactions. Analytical separation by liquid hydroprocessing reactions. Analytical separation by liquid chomatography has been carried out to produce nine distinct fractions from 1 kg of coal liquid. These have been further separated into compound classes and characterized in detail by elemental analysis, mass spectrometry, NMR, and infrared spectroscopy. Compounds typical of each fraction (except asphaltenes) have been designed. Hydroprocessing of polynuclear aromatic hydrocarbons under industrially relevant conditions has shown that these are much more reactive than benzene. The reaction networks involve reversible hydrogenation and isomerization, and significant concentrations of hydroaromatic (hydrogen-donor) species are attainable under practical conditions. Hydroprocessing of solutions containing the following combinations of compounds has also been studied: quinoline/indole, quinoline/indole/dibenzothiophene, and quinoline/indole/naphthalene. Lumping of components in a reaction network simplifies the kinetics determination of fuel feedstocks. Component lumping simulations involving first-order kinetics were successfully carried out for certain schemes in the quinoline network. This network can be represented by 3 simplified components. The quinoline and indole reaction networks are assumed to be made up of 4 lumps with the adsorption constants fixed, the intrinsic kinetic constants were recovered, and the lumping proved successful.

60727 **(DOE/ET/14880—06) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. Sixth quarterly report, August 15, 1980-November 15, 1980.** Gates, B.C.; Katzer, J.R.; Kwart, H.; Olson, J.H.; Schuit, G.C.A.; Stiles, A.B.; Petrakis, L. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering; Gulf Research and Development Co., Pittsburgh, PA (USA)). 31 Dec 1980. Contract AC22-79ET14880. 71p. NTIS, PC A04/MF A01. Order Number DE82019761.

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An asphaltene-containing SRC-II coal liquid derived from Powhatan No. 5 mine coal and produced in the Ft. Lewis demonstration plant has been selected for study of catalytic hydroprocessing reactions. Analytical separation by liquid chromatography has been carried out to produce nine distinct fractions from 1 kg of coal liquid. These has been further separated into compound classes and characterized in detail by elemental analysis, mass spectrometry, NMR, and infrared spectroscopy. Compounds typical of each fraction (except asphaltenes) have been designated. Simple LHHW models are proposed for the hydrotreating of quinoline, indole, napthalene and dibenzothiophene. Reaction schemes for the hydrotreating of binary mixtures of quinoline with napthalene, or with indole or dibenzothiophene were obtained by simple superposition of the reaction schemes for the individual components. Kinetics of hydrodenitrogenation of indole was studied in an autoclave between 321 and 400°C and 16.3 to 69 atm, using American Cyanamid Catalyst HDS-9A. A reaction network along with kinetic parameters is developed for the calculation of product distribution and nitrogen removal. Hydroprocessing of polynuclear aromatic hydrocarbons under industrially relevant conditions has shown that the reaction networks involve reversible hydrogenation and isomerization, and significant concentrations of hydroaromatic (hydrogen-donor) species are attainable under practical conditions. Hydroprocessing of solutions containing the following combinations of compounds has also been studies: quinoline/indole, quinoline/indole/dibenzothiophene, and quinoline/indole/napthalene.

60728 **(DOE/ET/14880—07) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. Seventh quarterly report, November 16, 1980-February 15, 1981.** Gates, B.C.; Katzer, J.R.; Kwart, H.; Olson, J.H.; Schuit, G.C.A.; Stiles, A.B.; Petrakis, L. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering; Gulf Research and Development Co., Pittsburgh, PA (USA)). 21 Oct 1981. Contract AC22-79ET14880. 76p. NTIS, PC A05/MF A01. Order Number DE82019762.

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An asphaltene-containing SRC-II coal liquid derived from Powhatan No. 5 coal and produced in the Ft. Lewis demonstration plant was selected for study of catalytic hydroprocessing reactions. Separation by liquid chromatography has been carried out to produce nine distinct fractions. Experiments have begun to determine the reactivities of these fractions in high-pressure catalytic hydroprocessing. Hydroprocessing experiments with aromatic hydrocarbons under industrially relevant conditions have shown that the reaction networks involve reversible hydrogenation and isomerization, and significant concentrations of hydroaromatic (hydrogen-donor) species are attainable under practical conditions. The least reactive class of aromatic hydrocarbons consists of substituted benzenes. Biphenyl has been selected for thorough study, and quantitative kinetics of the biphenyl hydrogenation to give cyclohexylbenzene has been determined. Kinetics of hydrodenitrogenation of indole was studied in an autoclave between 321 and 400°C and 16.3 to 69 atm, using American Cyanamid HDS-9A catalyst. A reaction network with kinetics parameters was developed for the calculation of product distribution and nitrogen removal. Lumping of components in a reaction network simplifies the kinetics determination of fuel feedstocks. Component lumping simulations involving first-order kinetics were successfully carried out for certain schemes in the quinoline network. This network can be represented by the reactant, the hydrogenated intermediate (lumps), and the denitrogenated product.

60729 **(DOE/ET/14880—08) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. Eighth and Ninth quarterly reports, February 15, 1981-August 15, 1981.** Gates, B.C.; Katzer, J.R.; Kwart, H.; Olson, J.H.; Schuit, G.C.A.; Stiles, A.B.; Petrakis, L. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering; Gulf Research and Development Co., Pittsburgh, PA (USA)). 30 Nov 1981. Contract AC22-79ET14880. 264p. NTIS, PC A12/MF A01. Order Number DE82019763.

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Kinetic models were developed for hydrogenation, hydrodesulfurmization and hydrodenitrogenation reactions during catalytic hydrotreating under industrially relevant process conditions. Model compounds were used to represent aromatic, nitrogen and sulfur compound types found in coal liquids, respectively naphthalene (N), quinoline (Q), basic nitrogen, indole (I), non-basic nitrogen, and dibenzothiophene (D). This study emphasizes the interaction between hydrogenation, hydrodenitrogenation, and hydrodesulfurization. Of special significance are the new results reported for binary and ternary mixtures. The kinetic model developed is based on proposed reaction networks and pseudo first-order kinetics. The objective was to develop removal, sulfur removal and hydrogen consumption. A Langmuir-Hinshelwood-Hougen-Watson (LHHW) kinetic model was found to be most useful in correlating the data and in permitting interpretation of the competitive behavior of strongly and weakly adsorbed reactants and products. Quinoline, indole, dibenzothiophene, naphthalene and their products were categorized into 5 kinetically significant adsorption groups to account for the interactions among the nitrogen-containing, sulfur-containing, and aromatic compounds during catalytic hydrotreating. Basic nitrogen-containing compounds adsorb two orders of magnitude more strongly than sulfur-containing or aromatic compounds and are the strongest inhibitor, indicating the importance of acidic sites in hydrotreating reactions. The kinetic models developed were

used for predicting hydrotreating kinetics in ternary mixtures, and compared with experimental results.

60730 **(DOE/ET/14880—09) Kinetics and mechanism of catalytic hydroprocessing of components of coal-derived liquids. Tenth and eleventh quarterly reports, August 16, 1981-February 15, 1982.** Gates, B.C.; Katzer, J.R.; Kwart, H.; Olson, J.H.; Schuit, G.C.A.; Stiles, A.B.; Petrakis, L. (Delaware Univ., Newark (USA). Center for Catalytic Science and Technology; Gulf Research and Development Co., Pittsburgh, PA (USA)). 26 Mar 1982. Contract AC22-79ET14880. 31p. NTIS, PC A03/MF A01. Order Number DE82019764.

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Heavy distillate derived from SRC-II coal liquid has been separated into nine well-characterized fractions by preparative liquid chromatography. The neutral oils fraction is the most important fraction because it is the largest (73.5 wt % of the total) and the easiest to upgrade by hydroprocessing. Most of the sulfur in the heavy distillate is concentrated in this fraction. The elemental analysis indicates the following heteroatom composition of the neutral oils 0.72% 0, 0.62% S, 0.06% N by weight (compared to 2.3% 0, 0.44% S, 1.1% N in the total heavy distillate). The hydroprocessing of this fraction has been studied in a high-pressure plug flow microreactor and a standard batch autoclave reactor using a standard commercial $NiO-MoO_3/\gamma-Al_2O_3$ catalyst. Pseudo first-order rate constants were determined for the hydrodesulfurization of three sulfur-containing compounds. The weight hourly space velocity was in the range of 0.05 to 0.4 g of neutral oils/(g of catalyst.h) at 350°C and 120 atm. The effect of temperature was investigated at 120 atm and a WHSV of 0.2 g of neutral oils/(g of catalyst.h) at 325, 350, 375, and 400°C. The effect of pressure was investigated in the range 120 to 150 atm. Most experiments were done with $Ni-Mo/Al_2O_3$ catalyst; one experiment was carried out with $Co-Mo/Al_2O_3$ catalyst under standard conditions (350°C, 0.2 WHSV, 120 atm). An experiment was done using the neutral oils fraction spiked with 4-methyldibenzothiophene. The results show that there is little hydrogenation even when hydrodesulfurization is almost complete.

60731 **(DOE/MC/10190—T1) Hydrogasifier development: conceptual design of single-stage commercial scale and process development scale hydrogasifiers.** (Dravo Corp., Pittsburgh, PA (USA). Synthetic Fuels Dept.). Sep 1978. Contract AC21-76MC10190. 31p. NTIS, PC A03/MF A01. Order Number DE82015864.

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An evaluation of the process requirements resulting from changing the Hydrane process from a two-stage hydrogenation to a single-stage hydrogasification process was undertaken by the Dravo Corporation for the Morgantown Energy Research Center, US Department of Energy, Morgantown, West Virginia. Hydrogenation is the reaction of coal with hydrogen to produce gaseous and/or liquid products. Hydrogasification is the gasification of coal by direct reaction with hydrogen to produce gaseous products products only. The present single-stage process scheme has further developed hydrogasification to incorporate rapid heating of fine coal particles (70%, -200 mesh) to the reaction temperature (1600 to 2000°F). The heating rate has been estimated to be in excess of 1 x 10^{60}K per second. The combination of the two foregoing operations, i.e., rapid heating of the particle in an atmosphere of hydrogen, results in devolatilization of the coal particles and rapid reaction of devlatilized hydrocarbons with hydrogen. This process has also been termed flash hydropyrolysis. The advantages which accrue to this process are: increased throughput, high methane yield, single pass and simple design.

60732 **(DOE/MC/14380—1210-Vol.1) Prediction and measurement of optimum operating conditions for entrained coal-gasification processes.** Hedman, P.O.; Smoot, L.D.; Smith, P.J. (Brigham Young Univ., Provo, UT (USA)). Dec 1981. Contract AC21-80MC14380. 193p. NTIS, PC A09/MF A01. Order Number DE82015612.

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This volume reports experimental and theoretical results of a twenty-six month study of entrained coal gasificaton with steam and oxygen. The gasifier facility and testing methods were revised for improvement in data accuracy. Fourteen tests were conducted in a laboratory gasifier to determine effects of inlet gas composition, temperature and swirl number on carbon conversion. A major increase in carbon conversion was observed with oxygen in the feed stream with the coal. The gasifier facility was also rebuilt for pressures to 250 psi and cold flow tests demonstrated facility operation to the maximum pressure. Sulfur pollutants were measured in eleven additional gasification tests. Methods for sulfur analysis were developed and the accuracy determined. Gasifier tests were also performed to support Los Alamos National Laboratory development of optical methods for analysis of gasifier effluents. A laser-Doppler velocimeter (LDV) was demonstrated for measurement of instantaneous velocity and turbulence intensity in non-reactive flows. Six tests were completed with the LDV system. The one-dimensional coal gasification code (1-DICOG) was upgraded, a revised user's manual prepared (Vol. II) and 133 runs were performed. The two-dimensional coal gasification code was completed (PCGC-2), a user's manual prepared (Vol. III) and several computations performed. Eight technical papers based on results of this study were published or prepared.

60733 **(DOE/MC/14400—06) Development of Beacon technology. Quarterly report, July-September 1981.** (TRW, Inc., Redondo Beach, CA (USA)). Jun 1982. Contract FC21-80MC14400. 51p. NTIS, PC A04/MF A01. Order Number DE82016246.

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The BEACON process involves the catalytic deposition of carbon from a gas stream containing carbon monoxide, and subsequent exposure of this carbon to a gas stream containing hydrogen or steam at elevated temperature and pressure to produce methane. The steam gasification route currently is receiving the most attention. Multiple-cycle tests with K1 and K2 catalysts showed sustained activity and stable performance through thirty of the planned forty cycles. The tests will be completed next quarter. Steaming temperature screening tests on K2-based BEACON carbon supported the conclusion based on earlier testing with K1-based BEACON carbon that steam gasification at two temperature levels has significant advantages over steam gasification at a single temperature in terms of gasification rates and methane yields. Multiple-cycle testing of K2-based BEACON carbon was started in the 4-inch bench-scale fluid bed reactor. Catalyst C77 continued to have problems during multiple-cycle testing - loss of catalytic activity, possibly due to overheating, and poor fluidizability. Further modifications of the C77 catalyst preparation technique were tested. Catalyst C77-K2 showed no change in performance, and results with catalyst C77-K1 were generally disappointing. Laboratory experiments continued with catalyst C78. A variable differential pressure concept which does not require gas/solids separtion is now being considered for the transfer of BEACON solids between carbon deposition and carbon gasification reactors.

60734 **(DOE/MC/16477—T4) Evaluation of the final data for the Pricetown I UCG field test via existing thermodynamic models. Quarterly progress report No. 9, February 20, 1982-May 21, 1982.** Eddy, T.L.; Gibbs, R.T. (Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering). 1982. Contract AC21-81MC16477. 15p. NTIS, PC A02/MF A01. Order Number DE82015776.

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60735 (DOE/METC—82-47, pp 1-17) **Overview to DOE/Fossil Energy's Gas Stream: contaminant control projects. Second annual contractors' meeting on gas stream cleanup.** Neal, J.; Moore, B.; Podall, H. 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

High temperature/high pressure cleanup of gasifier gas streams for downstream use with open cycle turbines is desirable, especially in conjunction with the use of low-Btu gas where the sensible heat is an appreciable fraction of its heat content. Hot cleanup of the gas stream prior to use in downstream power conversion equipment (open cycle turbines and molten carbonate fuel cells) eliminates the requirement for recuperative heat exchangers used with conventional low temperature gas quench cleanup processes thereby improving overall system efficiency and economics.

Also, waste disposal from hot gas cleanup systems appears simpler than that of low temperature cleanup which usually requires treatment of the water used to quench the hot gas. The particulate and alkali-laden PFBC gas streams have to be cleaned to acceptable levels prior to expansion through a power recovery turbine for conversion of the stream's energy to shaft power. It is essential that removal of contaminants from the PFBC be at or near the temperature and pressure of the combustor, since the gas contains no fuel value and power generation is based solely on the temperature and pressure of the gas stream. Hot gas cleanup appears to be the most important technical issue yet to be resolved with respect to commercialization of PFBC Combined Cycle Technology. In order that the cleanup train provide optimum system performance, it should be appropriately selected from a system point of view in conjunction with the pressure drops in the combustor, turbine and remaining system elements.

60736 (DOE/METC—82-47, pp 40-59) **Summary of coal gasification technology.** Strickland, L.D. (Morgantown Energy Technology Center, WV). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The total number and variety of synfuel projects in the US has significantly increased during the past 5 to 10 years. The extent of this activity is indicated by the number of commercial, demonstration, pilot, and process development units in various stages of development. Summing the total projects in each stage (excluding inactive or terminated), we see that there are approximately 114 gasification projects in the USA. The role of the Department of Energy has recently been redefined to emphasize long-range, high-risk, high-payoff basic research targets as opposed to larger developmental efforts aimed at commercialization of a technology. Accordingly, DOE is now involved in a variety of old and new activities consistent with a transition to the new R and D role. The major thrusts of this program are to establish strong integrated data bases for both engineering and environmental analyses and to move into a stronger R and D position. The data base activities are particularly important since much of the data and opportunities for obtaining new pilot or PDU data must be captured before the particular projects are terminated. Both system modeling, employing semi-empirical black box approaches, and detailed phenomenological models are being developed and emphasized as tools for understanding the diverse data base and for planning new research. A summary of DOE activities in regard to the monitoring of feasibility studies, a brief status of the SFC activities, and a status statement relating to DOE pilot plant and PDU activities are given. While the fate of the various pilot plant/PDU plants are not known with certainty, it is fair to say that the new DOE mission orientation towards high-risk, high-payoff, long-range research is inconsistent with a program containing a multitude of relatively large-scale projects such as these.

60737 (DOE/METC—82-47, pp 312-331) **Gasification cleanup requirements.** Frumerman, R. (Frumerman Associates, Inc., Pittsburgh, PA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The gas cleanup system lies between the gasifier and the end user. Its main function is to remove from the gas those constituents which would pollute the atmosphere or interfere with the efficient operation of the end user. How the cleanup system is designed depends on what materials it must remove and the level of cleanliness required. Hence its performance is fixed not only by the needs of the product gas user but by the composition of the hot, raw gas from the gasifier as well. The contaminants in the dirty gas are determined by the composition of the coal, the type of gasifier, and the operating conditions of the gasifier. This interdependence is illustrated by Figure 1. The gas cleanup system acts to protect more than the ultimate gas utilization system. In the case where methanation is part of the gas treating process, it shields the methanation catalyst from sulfur compounds which would poison the catalyst and from particulates that would clog the catalyst bed. The cleanup system also protects gas transmission lines from corrosion and erosion. Table 1 shows that the allowable level of contaminants in the product gas for each of several applications. These applications together comprise virtually all uses of gas from coal projected for the United States.

60738 (DOE/METC—82-47, pp 332-359) **Development and testing of regenerable hot coal gas desulfurization sorbents.** Grindley, T. (Department of Energy, Morgantown, WV); Steinfeld, G. 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

Investigations over several years at the Morgantown Energy Technology Center have been concerned with the development of a regenerable metal oxide desulfurization sorbent which would function on hot coal-derived fuel gas. In the latest phase of testing, a combination of zinc oxide with iron oxide as zinc ferrite has produced a sorbent which has demonstrated regenerability and capability of removing sulfur from simulated hot coal gas to a level of 1 to 10 ppM by volume. The principal finding at this stage of the project is that the compound zinc ferrite and also iron oxide containing some zinc ferrite have hydrogen sulfide absorption performances very similar to those of zinc oxide. Extruded sorbents made from these compounds have been demonstrated to perform with varying ability in the temperature range 800°F (427°C) to 1400°F (760°C) at a space velocity of 2000 hourly and a hydrogen sulfide concentration of 2.7 percent. They have also been shown to be regenerable with a 50/50 percent v/v steam-air mixture at 1000°F (538°C) and hourly space velocity with no loss of absorptive power. Both zinc ferrite and zinc oxide appear to perform optimally in the middle of the temperature range, where absorption capacity is greatest. Surprisingly, the experimental results indicate no trend to a lower degree of hydrogen sulfide removal with rise in temperature. Zinc ferrite appears to be superior to zinc oxide in terms of its absorption capacity and resistance to sintering at higher temperatures.

60739 (DOE/METC—82-47, pp 360-375) **Metal oxide absorbents for H_2S control.** Jalan, V.M.; Brooks, C.; Georgakis, C.; Desai, M. (GINER, Inc., Waltham, MA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

With an objective to contribute to the integration of coal gasifier with advanced power generation systems, such as molten carbonate fuel cells, this study has investigated high temperature regenerable desulfurization processes in which the H_2S content of coal gases is reduced from 100 ppM to 1 ppM. Commercially available processes involve very low temperature scrubbing prior to use in the fuel cells and, consequently, introduces penalties in capital cost and system efficiency. Copper oxide/copper was selected from the four sulfur removal agents, Zno, V_2O_5/V_2O_3, WO_3/WO_2 and CuO/Cu, identified in previous studies as meriting further evaluation for application as a regenerable sorbent for the hot desulfurization of coal synthesis gas. In particular, the advantages of using the CuO in a supported configuration have been demonstrated in the present study. Experimental verification has been obtained that the average value for mole percent conversion of 10 ppM breakthrough ranges from less than 1% for unsupported CuO to about 80% for CuO supported on zeolite. Structural stability combined with high dispersion of the CuO appear to be key factors in optimizing the desulfurization performance for supported CuO sorbents. In the continuing research efforts, our emphasis is on the following: (a) highly dispersed supported systems to provide cost effective sulfur removal; (b) use of steam-air mixtures to achieve efficient regeneration and to maintain structural integrity; and (c) an engineering study to determine necessary design parameters and operational parameters for process optimization and process scale up.

60740 (DOE/METC—82-47, pp 376-390) **Regeneration of iron-based H_2S absorbents.** Tamhankar, S.S.; Wen, C.Y. (West Virginia Univ., Morgantown). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The Morgantown Energy Technology Center (METC) has developed a sorbent consisting of 45 wt % Fe_2O_3 and 55 wt % SiO_2 for the removal of H_2S from gasifier product gases at high temperatures. The overall process consists of two stages: absorption or H_2S removal stage and sorbent regeneration stage. Efficient regeneration of the spent sorbent is important from an economic viewpoint, and several regeneration methods have been proposed.

Studies at West Virginia University are aimed at eludicating the kinetics and the mechanisms of reactions involved in the absorption and regeneration steps. Past results for the reactions in H_2S absorption and sorbent regeneration by air/SO_2 are first briefly discussed here. The present efforts address regeneration of sulfided sorbent using steam-air mixtures. Preliminary results are presented on the steam regeneration reaction, and a plausible mechanism is suggested. The work is in progress to obtain more detailed kinetic information.

60741 (DOE/METC—82-47, pp 391-415) **H_2S removal from coal gas at mid temperature (150 to 200°C).** Kimura, S.G.; Kim, B.M.; Schultz, J.A. (General Electric, Schenectady, NY). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

If it were possible to scrub H_2S at the quench exit temperature (150 to 200°C), the need for further gas cooling and condensate handling would be eliminated, and the cost of the gas cleanup plant might be cut by more than half. If, in addition, the ammonia could be scrubbed from the gas simultaneously, expensive ammonia absorption processes would not be needed. The simplified schematic diagram for coal gas cleanup incorporating mid-temperature (150 to 200°C) is shown in Figure 2. The benefits of mid-temperature H_2S scrubbing are summarized as follows: up to 60% reduction in cleanup system capital cost and components; substantially reduced process and controls complexity; opportunity for scrubbing of sulfur compounds and NH_3 in the same location; and elimination of the need for the condensate handling and recycle, and potential emissions resulting from these operations. This paper describes an initial evaluation of four potential absorbent candidates for H_2S scrubbing from coal gas at mid-temperature. Four candidate absorbents for H_2S scrubbing at mid temperature (150 to 200°C) have been evaluated and the results to date have been encouraging. All absorbents have shown excellent H_2S absorption capability and good H_2S/CO_2 selectivity. The $ZnSO_4$ absorbent was eliminated from consideration because of its poor regeneration under test conditions. It has been determined that three candidate absorbents, $Ni(OH)_2$, coal ash leachate ($Fe(OH)_3$), and the Redox system show promise for absorption of H_2S from coal gas at mid temperature (150 to 200°C).

60742 (DOE/METC—82-47, pp 416-426) **Hot gas cleanup for molten carbonate fuel cells.** Gelb, A.; Ham, D.; Lewis, P.; Lord, G.; Simons, G. (Physical Sciences, Inc., Woburn, MA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

Candidates were screened to identify non-volatile compounds that will react to remove HCl from a gas stream at temperatures between 800 to 1100°K. Conclusions of this study are: (1) $ZnCl_2$ and $FeCl_3$ are gaseous above 800°K and melt below 600°K. This could have severe implications for cleanup of sulfur with Zn/Fe oxides from streams where chloride is present; (2) very little information is available on kinetics and pore plugging of sorbents during chloride cleanup; however, we find that for cleanup by limestone (limited data is available) that chloride enhances sulfur cleanup rates and should not plug the pores as long as the chlorine level is less than the sulfur level; (3) the alkali carbonates appear to be by far the best sorbents for combined sulfur/chloride cleanup. The predicted gas phase chloride levels over these sorbents is less than 10^{-5} atm at 900°K and less than 10^{-6} atm at 800°K. Experiments run with various gas mixtures on smooth Ni surfaces, supported Ni catalyst and anode material have led to the conclusion that the Boudouard reaction for carbon deposition is much faster at fuel cell conditions than either the water shift reaction or the methanation reaction. These results imply that carbon may form on MCFC anodes even for conditions where equilibrium calculations predict no carbon. Addition of CO_2, probably from anode gas recycle, will inhibit coke formation even if the shift reaction is too slow to accommodate changing compositions.

60743 (DOE/METC—82-47, pp 427-437) **Evaluation of gasification and gas cleanup processes for use in molten carbonate fuel cell power plants.** Vidt, E.J.; Alvin, M.A.; Wenglarz, R.A. (Westinghouse R and D Center, Pittsburgh, PA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The DOE is funding two major programs for the development of molten carbonate fuel cell (MCFC) power systems for utility and industrial applications. While the high-temperature MCFC is a promising concept for future power generation, especially when fueled from an integrated low- or medium-Btu coal gasifier, we anticipate that the MCFC will be sensitive to coal-derived contaminants such as sulfur, halogens, and particulates. These contaminants may poison catalysts, damage electrodes and electrolytes, and clog passages. In view of the above, it is mandatory to project the MCFC tolerances of coal-derived contaminants and to assess the potential of existing and developing cleanup technology for meeting these tolerances. The objective of this program is to evaluate and compare coal gasification and gas cleanup processes on a system basis for use in advanced MCFC-based power plants, including topping and/or bottoming cycles. Specifically, the goals are to: predict MCFC tolerance of contaminants found in coal; identify gasifier/cleanup combinations suitable for application to MCFC-based power plants; develop parameterizations that accurately describe the overall performance and cost of alternative integrated MCFC plant subsystems; and select optimal power plant configurations, with emphasis on efficiency, operability, cost, and effluents.

60744 (DOE/METC—82-47, pp 438-464) **High-temperature removal of alkali vapors in hot gas cleaning systems.** Mulik, P.R.; Alvin, M.A.; Bachovchin, D.M. (Westinghouse Electric Corp., Pittsburgh, PA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

This program is directed at performing experimental and analytical investigations, system designs, and cost estimates to ascertain the feasibility of using aluminosilicate-based getters for controlling alkali in pressurized, hot-gas cleaning systems. Its overall objective is to develop a comprehensive plan for evaluating a scaled-up version of the gettering process as a unit operation or as an integral part of a particulate removal device. This paper describes work completed under this project on thermodynamic projections, getter selection and qualification, and system performance projections. Getter selection and qualification efforts involved additional kinetic studies utilizing both our bench-scale and thermogravimetric analysis unit. The bench-scale studies involved runs with activated bauxite in an inert carrier gas containing KCl, and NaCl, and NaCl/water vapor. In addition, a series of screening tests were conducted to evaluate 20 candidate getter materials. TGA studies focused on a detailed evaluation of activated bauxite along with preliminary ancillary tests needed to define a good operating procedure. Based on available data and modeling efforts, we concluded that long contact times must be provided for effective gettering, so deep packed beds appear to be the best approach of the various contacting devices considered. With such an approach, bed heights of about 10 m for activated bauxite and about 1 m for ash would be required, if we assume annual replacement on the basis of bed saturation capacity. Our recent screening tests have revealed several candidates that appear to perform more effectively than the getters mentioned above.

60745 (DOE/METC—82-47, pp 528-537) **Development of a solid absorption process for removal of sulfur from fuel gas.** Stegen, G.E. (Battelle Pacific Northwest Labs., Richland, WA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

On August 1, 1979, Battelle Pacific Northwest Laboratories began a project to develop the Solid Supported Molten Salt Process for removing sulfur compounds from fuel gases at elevated temperature (>700°C). This process is based on the use of molten mixtures of alkali metal carbonates and calcium carbonate as the active reactants for removing sulfur compounds. The sulfur removal capacity of the molten salt mixture may be regenerated by stripping with CO_2 and steam, usually at a reduced temperature. In this process, the molten salt mixture is contained within the pores of a porous ceramic substrate material. The absorbent material may be used in a packed bed, moving bed, or fluidized bed absorber. Additional information on the process is contained in the first seven

progress reports for this project. Thirty-five absorption/regeneration runs have been completed. Thirty-one of these were made with a single bed of sorbent. This sorbent was prepared with -7 +14 mesh lithium aluminate ceramic as the support and initially contained 0.68 g mole of salt.

60746 **(DOE/NASA—0277-1) Low- and medium-heating-value coal-gas catalytic-combustor characterization.** Schwab, J.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). Nov 1981. Contract AI01-77ET10350. 136p. (NASA-CR—165560). NTIS, PC A07/MF A01. Order Number DE82021964.

Successful catalytic combustor operation was obtained with both low- and medium-heating-value gasifier-produced coal gas. The DOE/Westinghouse gasifier was operated with Indiana No. 7 coal and operated in both an enriched-air and oxygen-blown mode to produce both low- and medium-heating-value gas. Efficient operation of the catalyst was obtained with low-heating-value coal-derived gas. Combustor efficiencies of 99.5% and above were measured. Axial temperature rise through the catalyst was much more rapid than for liquid fuel, with 70 to 80% of the catalyst temperature rise occurring across the first catalyst element. Trends observed include increased combustion efficiency at increasing inlet temperatures and decreasing reference velocity or pressure. Catalyst performance degraded with test time. Efficient operation was also obtained with medium-heating-value gas. Combustion efficiencies of 99.5% and above were obtained with medium-heating value gas. A degradation in catalyst performance was again observed with increasing run time. Both low- and medium-heating-value coal-gas-fired tests produced NO/sub x/ levels ranging from 10 to 19 ppmv at 15% O_2. A slight upward trend of NO/sub x/ with increased equivalence ratio was observed for medium-heating-value gas. This observation may be due to thermal NO/sub x/ production as a result of localized hot spots from fuel-air non-uniformities. The 14 ppmv baseline NO/sub x/ readings probably result from conversion of trace levels of ammonia and cyanide compounds in the product gas to NO/sub x/. In addition, as much as 1 to 2 ppM NO could be the result of gasifier-produced NO/sub x/.

60747 **(DOE/PC/30018—3) Flash hydroliquefaction of coal. Quarterly technical progress report No. 3, April 4, 1981-July 3, 1981.** Falk, A.Y. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 24 May 1982. Contract AC22-80PC30018. 120p. (ESG-DOE—13377). NTIS, PC A06/MF A01. Order Number DE82021594.

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Rockwell has developed a reactor which allows rapid and uniform mixing of pulverized coal with heated hydrogen through the use of a rocket-engine-type injector. The hydrogen is partially heated by indirect heating and further heated by partial combustion with oxygen to supply the required process heat. The amount of hydrogen fed is being kept as low as practicable because of the recycle implication for a complete process. Successful operation of a water-cooled heat-exchange quench unit without plugging or degradation has been demonstrated. Char is separated from the vapor-phase material in a separator which is maintained at a sufficiently high temperature to allow vapor-phase removal of the liquid products. The effectiveness of the concept has been demonstrated in a series of tests. Substantial liquid yields and high overall conversions are possible. A high-pressure product recovery system contains two condensers which split the liquid product into heavy and light oil fractions. In addition, an adsorber bed BTX recovery system was installed. The new system functioned well after an initial shakedown, and they allow for better separation and recovery of the products. Evaluation showed a very high thermal efficiency and favorable economics compared with other liquefaction processes. Many potential advantages of the process were noted; however, most of these advantages remain to be demonstrated. During the first two quarters of the Phase IV effort modifications were made to the PDU to improve material balances; the PDU was activated and six successful tests were conducted; and supporting dense-phase flow, product refining and utilization, and material studies were initiated. The PDU facility modifications made to improve material balances were quite beneficial. Material and major elemental balances for the Phase IV tests are within 5% of closure, a contract target value.

60748 **(DOE/PC/40782—T2) Desulfurization with transition-metal catalysis. Quarterly progress report, March 27, 1982-June 27, 1982.** Eisch, J.J. (State Univ. of New York, Binghamton (USA). Dept. of Chemistry). Jul 1982. Contract FG22-81PC40782. 5p. NTIS, PC A02/MF A01. Order Number DE82019079.

The principal objective of this research is to uncover new reagents and catalysts for upgrading coal-derived fuels by removing undesirable organosulfur, organonitrogen and, if feasible, organooxygen components. During the third quarter of this two-year grant the following studies were initiated or continued: (a) study of the desulfurizing action of nickel, cobalt and copper salts, combined with metal hydrides, on SRC plant liquids, (b) survey of the capability of low-valent nickel reagents to desulfurize, in one step, sulfones and other model organosulfur compounds; (c) development of molybdenum-based desulfurizing agents; and (d) exploration for denitrogenating agents suitable for quinolines and carbazoles. The following progress has been made: (a) nickel salts are superior to cobalt and copper salts in desulfurizing SRC liquids; in a two-step treatment, an SRC liquid was freed of 90% of its sulfur (0.5 to 0.05%); (b) in ethereal solutions vinylic and acetylenic sulfones can be reduced to sulfides by metal hydrides; inclusion of nickel salts gives some desulfurization; (c) some novel butadiene-molybdenum complexes have been synthesized for desulfurization studies; and (d) the treatment of quinoline and carbazole derivatives with nickel and titanium salts, combined with a metal hydride, is being evaluated as a possible denitrogenation procedure.

60749 **(DOE/PETC/TR—82/15) Sulfur reduction potential of the bituminous coals of Pennsylvania.** Wizzard, J.T.; Cavallaro, J.A.; Deurbrouck, A.W. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). Aug 1982. 333p. NTIS, PC A15/MF A01. Order Number DE82022070.

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This report presents the results of a washability study of 205 raw coal channel samples with an emphasis on sulfur reduction. These raw coals contained on the average 14.8% ash, 1.73% pyritic sulfur, 2.52% total sulfur, 12,812 Btu/lb, and 4.0 pounds of SO_2 emissions per million Btu, on a moisture free basis. The complete washability data and ultimate-proximate data are presented for these samples. Each individual washability analysis is presented in Appendix A. Statistical evaluations of the washability data and ultimate-proximate analyses are presented on a coalbed basis, whenever there are six or more samples from a given coalbed. An additional evaluation is included showing the composite data interpolated at Btu recovery levels of 50, 60, 70, 80, 90, and 100%. Graphical representations are given for various coal characteristics of both raw and washed coal fractions for all coalbeds with six or more samples. For coalbeds with 20 or more samples, goodness-of-fit tests were made comparing SO_2 distributions with both normal and log-normal distributions. Confidence intervals and tolerance limits are calculated and illustrated for the SO_2 emission values as a function of specific gravity for these coalbeds. In general, ash reduction, pyritic sulfur reduction, total sulfur reduction, and SO_2 emissions reduction increase as the coal is crushed to smaller top sizes and as the coal is cleaned at lower specific gravities. This report presents the reduction curves for the ten major coalbeds in Pennsylvania's Main Bituminous Coalfield.

60750 **(DOE/RA/50393—1241) Plant to produce 20,000 barrels per day of gasoline from coal. Executive summary.** (Hampshire Energy, Milwaukee, WI (USA)). 1982. Contract FG01-81RA50393. 12p. NTIS, PC A02/MF A01. Order Number DE82022000.

This Executive Summary presents results of Hampshire Energy's evaluation of the technical and economic feasibility of a plant to produce approximately 21,000 barrels per day of gasoline from coal. Located near Gillette, Wyoming, the plant would produce this gasoline and other marketable by-products by indirect liquefaction of 15,450 tons of Powder River Basin sub-bituminous coal. The results of the evaluation are summarized: resource assessment has confirmed the availability of the necessary coal, water,

electricity and natural gas supply; a suitable plant site is available; applications have been fired for all major permits required to construct and operate the plant; only commercially proven or commercially ready technologies have been included in the plant; process licenses are available for all units requiring licensing; the Hampshire configuration of process units is technically sound regarding operability, availability, controllability and maintainability; detailed process design and preliminary basic engineering designs have been developed from which the plant's investment and operating costs have been estimated; a project execution plan and schedule for engineering, procurement and construction have been developed; plant costs have been estimated as $1790 million in 4th Quarter 1981 dollars; commercial feasibility depends on support by the US Synthetic Fuels Corporation in the form of loan and price guarantees.

60751 **(EPRI-AP—2221) 300-Btu gas-combustor development program. Phase II. Final report.** Gilmartin, T.J.; Grant, J.R. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.; Pratt and Whitney Aircraft Group, West Palm Beach, FL (USA). Government Products Div.). Mar 1982. 170p. NTIS, PC A08/MF A01. Order Number DE82904631.

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This research project effort represents the second phase of a program directed towards developing a gas turbine combustor capable of meeting Environmental Protection Agency NO/sub x/ requirements when operated on medium heating value (MHV) coal-derived gas without the use of water injection. The overall program objectives were to design, fabricate, and test several lean-premix combustor configurations and demonstrate NO/sub x/ emissions of 15 ppMv (dry) or less at 1.27 atmospheres. Specific objectives of the Phase II effort were to improve ease of combustor fabrication and extend combustor operating range relative to Phase I designs. Two basic combustors were evaluated in the Phase II effort. The Configuration IV combustor represents a simplified multi-premix tube design while the Configuration V design is a two-stage combustor incorporating seven venturi-type premix elements. Tests were conducted in a single-can combustor rig at simulated engine conditions ranging from idle to 125% of engine baseload (74MW). Measured data included inlet and exit temperatures, pressures, and emissions of NO/sub x/, CO, CO_2, O_2, and total (unburned) hydrocarbons. Results showed that both combustors met the NO/sub x/ goal with concentrations of 14 ppM or less corrected (inlet pressure, percent O_2 and humidity). In addition, the Configuration V design demonstrated acceptable combustion efficiency/stability over the full range of simulated power levels.

60752 **(EPRI-AP—2535) Coking properties of coal under pressure and their influence on moving-bed gasification. Final report.** Lancet, M.S.; Curran, G.P.; Sim, F.A. (Conoco Coal Development Co., Library, PA (USA). Research Div.). Aug 1982. 131p. NTIS, PC A07/MF A01. Order Number DE82906456.

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The coking properties of seven bituminous coals, including three Eastern US coals, one Midwestern US coal, a Western US coal and two from the UK were studied with respect to the possible utilization of these coals in moving bed gasifier systems. Complete physical, chemical and petrographic analyses were obtained for each coal in addition to the highly specialized CCDC simulated gasifier coking test data. The effects of total pressure, hydrogen partial pressure, heating rate and the addition of gob and tar on the fluidity and swelling properties of each coal was studied. Samples of each coal were shock heated under pressure to simulate coking in the top of a Lurgi gasifier. The resultant cokes were tested for various physical properties and the product yields were determined. Gas release patterns during pressurized pyrolysis were obtained in several instances. The data obtained in this work should provide a valuable data base for future gasifier feedstock evaluation programs.

60753 **(LBL—14491) Oxydesulfurization of coal.** Cremer, G.A.; Mixon, D.A.; Ergun, S.; Vermeulen, T. (Lawrence Berkeley Lab., CA (USA)). May 1982. Contract AC03-76SF00098. 94p. NTIS, PC A05/MF A01. Order Number DE82020980.

Thesis. Submitted by G. A. Cremer.

Pyrite, a principal sulfur-bearing component of high-sulfur coals, reacts with oxygen to form ferric sulfate and sulfuric acid. By using these products as the reaction medium, the use of water is minimized, and the products are recoverable in essentially pure form. The reaction kinetics for oxidation of native pyrite and oxidation of pyrite in coal are compared in the range of 100 to 150°C, and it is concluded that acid iron-sulfate media provide an effective means for inorganic sulfur removal. On the other hand, removal of organic sulfur is difficult to achieve without significantly lowering the heating value of the coal. Therefore the economic use of acidic oxidation is likely to be limited to coals in which pyrite comprises a large part of the total sulfur content.

60754 **(ORNL/MIT—352) ASPEN simulation of the SNG production process in an indirect coal-liquefaction plant.** Bistline, J.E.; Shafer, T.B. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Aug 1982. Contract W-7405-ENG-26. 53p. NTIS, PC A04/MF A01. Order Number DE82021107.

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The synthetic natural gas (SNG) production process (methanation, CO-shift, and hydrogen removal) in an indirect coal-liquefaction plant was simulated using the Advanced System for Process Engineering (ASPEN). The simulation of the methanation unit agreed to within 12% of Fluor's design for converting carbon monoxide and carbon dioxide. A parametric study examined the effect of four important operating parameters on product composition, process thermal efficiency, and outlet temperature from the second methanation reactor. The molar split of gas feed to the CO-shift unit before methanation was varied from 0.2 to 0.6; variations of molar recycle ratio (0.01 - 0.67), molar steam-to-feed ratio (0.04 - 0.19), and feed temperature (478 - 533 K, 400-500°F) to the first methanation reactor were also studied. A 50%-lower split improved thermal efficiency by 6%, but the mole % hydrogen and carbon monoxide in the product SNG required to meet pipeline-quality standards and temperature constraints were not met. Increasing the steam-to-feed ratio from 0.04 to 0.19 improved product quality but decreased thermal efficiency by 8%. By decreasing the feed temperature from 533 to 477 K (500 to 400°F), product specifications and temperature constraints were met with no effect on thermal efficiency. However, it may be impractical to operate the reactor at 477 K (400°F) because the kinetics are too slow. Increasing the recycle ratio from 0.4 to 0.67 had no effect on thermal efficiency, and temperature constraints and product specifications were met. The SNG production process should be optimized at recycle ratios above 0.67.

60755 **(ORNL/TM—8160) Preliminary flashing multiphase flow analysis with application to letdown valves in coal-conversion processes.** Ott, L.J.; Khan, A.A. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 127p. NTIS, PC A07/MF A01. Order Number DE82021090.

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As part of the Oak Ridge National Laboratory's technical support to large coal liquefaction projects, attempts have been made to (1) develop the methodology for characterizing and predicting multicomponent, multiphase, non-Newtonian flow behavior within letdown valves and devices, and (2) analyze the fluid flow in the entire letdown region of the process. An engineering model that can be used in the analysis of multicomponent, multiphase, flashing, flowing systems has been developed. A preliminary version of a user-oriented computer code for this model has been developed and is fully described.

60756 **(ORNL/TM—8427) Sample management and chemical/physical properties of products and effluents from the University of Minnesota-Duluth, low-Btu gasifier.** Griest, W.H.; Clark, B.R. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 95p. NTIS PCE04/MF A01. Order Number DE82021181.

Includes 2 sheets of 48 reduction microfiche.

This ORNL/TM describes the sample management and chemical and physical characterization of the materials collected at the gasifier site. The feed coal, wet bottom ash, cyclone underflow, electrostatic precipitator (ESP) tar, lock hopper cyclone underflow,

ash pan water, and process water were sampled periodically in the 1979-1981 heating seasons. The raw and cleaned top and bottom gases, the combined gas, and the boiler stacks also were sampled in the 1980-1981 season. The wet ash was the main recipient of the inorganic species from the feed coal. Trace elements accumulated into the wet ash by an average factor of 6.4, which is close to the factor expected from their relative ash contents. The ash pan water did not effectively leach the inorganic or organic components of the wet ash; the only elements detected in ash pan water were Fe, Zn, K, Si, and Ba, and none exceeded 2 μg/ml. The elemental analyses of the gas stream samples showed variations of as much as three orders of magnitude among samples taken at the same point, suggestive of serious difficulties in sample collection. The main elements in the combined gas stream were Cr, Pb, Ba, and Se (ranging from approx. 1 to 3000 $\mu g/m^3$). Cr (highly variable) and Pb (approx. 6 $\mu g/m^3$) were the main elements found in the stack gases. In contrast, ammonia and cyanide in the combined gas (1800 and 200 ppm [vol./vol.], respectively) were contributed predominantly by the top gas stream. Levels of these constituents were reduced by factors of 500 to 1000 in the stack gases. The ESP tar was the main organic byproduct of the gasifier. Chemical class fraction distribution and specific compound content were typical of coal-derived liquids. The organic compounds detected in the gas streams were C_2- and C_3-alkylated benzenes, alkyl-indanes/styrenes, alkyl naphthalenes, alkyl phenols, and aliphatic hydrocarbons.

60757 **(SAND—82-0341) Improving the dependability of critical thermocouple thermometry for fossil-fuel gasifiers and retorts.** Reed, R.P. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1982. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01. Order Number DE82020053.

Critical thermocouple thermometry is such a measurement in which either excessive error or loss of signal can result in unacceptable consequences. To avoid these consequences, it is necessary that the thermometry survive whatever adverse environment accompanies the measurement; however, it is just as essential to accomplish definite, adequate, demonstrated accuracy. This report describes some of the more significant problems involved in applying thermocouple thermometry in hostile environments. For example, a hostile environment is encountered in some locations in gasifiers and retorts; there sensor damage is likely. A model of defective thermocouples is used to describe several damage mechanisms, their effects on dependability, and the symptoms that allow their detection. The model illustrates why many significant errors can occur unrecognized and demonstrates the practical need for real-time validation diagnostics. Special continual diagnostic techniques are described that can help to establish the dependability of critical measurement throughout the period of use. The principles of reliability and survivability are applied to a particular problem: the thermocouple thermometry of the process gas stream in Stage I of the DOE Homer City, PA, coal gasification pilot plant. In that plant, process control is partly based on thermometry. Survival rates of thermocouple probes in early process runs were unsatisfactory. On the basis of previously reported data, this report concludes that failures tended to be mechanically rather than chemically caused and that thermometry failure has significantly preceded gross breakage or breaching of thermowells. Alternate methods to reduce such failure and to document reliability are suggested.

60758 **The status of the Cool Water Coal Gasification Program.** Papay, L.T.; Engel, P.K. (Southern California Edison Company, P.O. Box 800, Rosemead, CA 91770). *Transactions of the American Nuclear Society;* **41**: 4(Jun 1982). (CONF-820609—).

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

60759 **Utah char-oil project.** Thurgood, J.R.; Wareham, F.D. (Utah Power & Light Company, P.O. Box 899, Salt Lake City, UT 84110). *Transactions of the American Nuclear Society;* **41**: 5(Jun 1982). (CONF-820609—).

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

60760 **Direct liquefaction of coal-accomplishments, status, and prospects.** Cochran, H.D.; McNeese, L.E. (Oak Ridge National Laboratory, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **41**: 6(Jun 1982). (CONF-820609—).

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

60761 **Synthetic fuels-developments outside North America.** Baker, A.; Teper, M. (IEA Coal Research, Economic Assessment Service, 14/15 Lower Grosvenor Place, London, SW1). *Transactions of the American Nuclear Society;* **41**: 7(Jun 1982). (CONF-820609—).

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

60762 **Primer on coal utilization technologies.** *Reviews of Modern Physics;* **53**: No. 4, S53-S72(Oct 1981).

This section contains brief introductory characterizations of the most important technologies currently in use or under development; topics discussed include: pyrolysis; flow conditions in combustion and conversion processes; gasification; direct liquefaction; indirect liquefaction; direct combustion; magneto-hydrodynamic conversion (MHD); combined cycles and co-generation; high temperature fuel cells; and mining and coal preparation. Pyrolysis, the general phenomenology of gasification, and flow conditions are discussed first since they are of general and recurrent interest. Discussion of these is followed by descriptions of several specific processes. The drive for ever higher efficiency in coal fired boilers and the need for petroleum substitutes on a large scale have inspired efforts to develop science-based technologies covering a wider range of applications and concerns than the traditional ones. The task is very difficult partly because of the inherently variable and ill defined nature of coal itself, partly because multiphase flows and chemical reactions at solid surfaces are intrinsic features of the technology, and partly because the hetero-atom and mineral content of coal gives rise - whatever the mode of use - to toxic or harmful residues which must be controlled. Efforts in the United States to develop and refine modern coal technology are largely financed by industry and by the US Department of Energy. The effort is broad in scope and of substantial size.

60763 **Instrumentation and control.** *Reviews of Modern Physics;* **53**: No. 4, S73-S96(Oct 1981).

The lack of data necessary for fundamental understanding of advanced fossil energy processes largely is caused by a deficiency in diagnostic instrumentation to make detailed measurements of process behavior, coupled with a lack of access to experimental facilities. To the end of providing these data and ultimately making possible the control of the advanced fossil energy processes, we recommend the following: (1) for the purpose of improved process control, present research directed toward increasing our ability to measure - and thereby monitor - process parameters under the harsh corrosive environments of coal utilization plants, including temperatures over 1000°C and pressures of 1000 psi, must be expanded; (2) for improved efficiency and safety, instrumentation researches must be aimed at techniques permitting real-time monitoring of as many process parameters as possible, especially of reactor temperatures; (3) in view of the present paucity of reliable instrumentation for coal plant process controls, a systematic evaluation of available commercial and developmental instrumentation should be undertaken, with the objectives of identifying promising present techniques and encouraging their improvement; (4) to achieve the reliable process controls needed for efficiency and safety, not only must present instrumentation techniques be improved, but investigations of possible new techniques will have to be actively encouraged; (5) to assist the development of new instrumentation and the improvement of presently available instruments, the full range of electromagnetic and acoustic radiations from reactor process components should be carefully studied for possible extraction of information; and (6) reactor modeling efforts must be greatly increased.

60764 **Modeling and flow theory.** *Reviews of Modern Physics;* **53**: No. 4, S97-S107(Oct 1981).

(1) We recommend the establishment of an experimental test facility, appropriately instrumented, dedicated to research on theoretical modeling concepts. Validation of models for the various flow regimes, and establishment of the limitations or concepts used in the construction of models, are sorely needed areas of research. There exists no mechanism currently for funding of such research on a systematic basis. Such a facility would provide information fundamental to progress in the physics of turbulent multi-phase flow, which would also have impact on the understanding of coal utilization processes; (2) combustion research appears to have special institutional barriers to information exchange because it is an established, commercial ongoing effort, with heavy reliance on empirical data for proprietary configurations; (3) for both gasification and combustion reactors, current models appear to handle adequately some, perhaps even most, gross aspects of the reactors such as overall efficiency and major chemical output constituents. However, new and more stringent requirements concerning NOX, SOX and POX (small paticulate) production require greater understanding of process details and spatial inhomogenities, hence refinement of current models to include some greater detail is necessary; (4) further progress in the theory of single-phase turbulent flow would benefit our understanding of both combustors and gasifiers; and (5) another area in which theoretical development would be extremely useful is multi-phase flow.

60765 **Materials in coal conversion and utilization.** *Reviews of Modern Physics;* **53**: No. 4, S108-S124(Oct 1981).

We recommend expanded and strengthened effort on computer simulations of interactions between the lattice and foreign atoms. We recommend surface science studies of the manner in which hydrogen gains entry to the lattice. We recommmend intensified study of all aspects of solid particle erosion - including the mechanisms of material removal, the dependence on kinematical variables and temperature, and the dependence upon particulate properties. We recommend broadened and systematic studies of the transport of minor oxidants and substrate atoms through protective oxide films, with special effort to understand the pathways involved. We recommend the use of multicomponent diffusion theory to understand the cooperative relationship between sulfide and carbide formation at the substrate-film interface and their subsequent oxidation and consequent disruption of the protective film. We recommend use of the methods of surface physics to study the mechanisms by which alkali sulfates attack metal surfaces and their protective films and the mechanisms of scale formation and spallation. We recommend fundamental studies to elucidate the nature of erosion-corrosion which at present is poorly understood. We recommend increased efforts to complete the phase diagrams that are critical for understanding refractories in slagging environments. We recommend that research on the kinetics of refractory dissolution by slags be strenghtened and encouraged.

0106 Properties

REFER ALSO TO CITATION(S) 60717, 60758, 61858

60766 **(ANL/FE—82-6) Thermal-neutron-capture prompt-gamma emission spectra of representative coals.** Herzenberg, C.L.; Olson, I.K. (Argonne National Lab., IL (USA)). Dec 1981. Contract W-31-109-ENG-38. 115p. NTIS, PC A06/MF A01. Order Number DE82021144.

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Prompt gamma ray emission spectra have been calculated from 1.5 to 11 MeV for a wide range of coal compositions exposed to a thermal neutron flux. These include contributions to the spectra from all of the major and minor elements present in the coals. Characteristics of the spectra are discussed and correlated with the coal compositions.

60767 **(CONF-821106—4) Application of multiparameter corresponding states methods to predict the thermodynamic properties of polar and associating pure coal fluids.** Watanasiri, S.; Kumar, K.H.; Starling, K.E. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 1982. Contract FG22-80PC30249. 33p. NTIS, PC A03/MF A01. Order Number DE82021544.

From Annual meeting of heat transfer and energy conversion; Los Angeles, CA, USA (14 Nov 1982).

A multiparameter corresponding-states correlation has been developed to accurately predict thermodynamic properties of nonpolar, polar, and associating compounds. The correlation parameters include critical temperature, critical density, structure factor, dipole moment, and three polar/associative parameters. The correlation was applied to predict vapor pressure, and density of a wide variety of polar and associating compounds including water, ammonia, alcohols, ethers, ketones, amines, mercaptans, cresols, xylenols, and indanols. The average absolute deviations for vapor pressure and density are 2.3% and 2.8%, respectively. 4 tables.

60768 **(DOE/PC/40789—T1) Thermal and radiative properties of coal-ash deposits. Technical progress report No. 1, September 1, 1981-February 28, 1982.** Anderson, D.W.; Fetters, D.G.; Incropera, F.P.; Viskanta, R. (Purdue Univ., Lafayette, IN (USA). School of Mechanical Engineering; Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). 1982. Contract FG22-81PC40789. 8p. NTIS, PC A02/MF A01. Order Number DE82015159.

Because the energy balance (calorimetric) method is the only one not based on local measurements and therefore yields average heat flux across the deposit, the calorimetric method was considered to be the preferred method for determining the effective (conduction plus radiation) thermal conductivity of the coal-ash deposit. Some typical results obtained are illustrated in Figure 3. The temperature difference across ~ 10 mm deposit layer were typically in the range from 200 to 300°C; however, it can be as low as 100°C or as high as 500°C. The effective thermal conductivities obtained for the heating and cooling portions of the same experiment were approximately the same, indicating that the samples did not sinter. It is expected that, if the deposit had sintered, conductivities would be larger for the cooling part of the cycle. This conclusion is further supported by visual inspection of the samples made at the end of each run, which indicated no signs of fusion or sintering. It is clear from the results obtained that a softening point of typical coal-ash deposits cannot be reached in the present experimental facility, and that a furnace (kiln) capable of reaching significantly higher temperatures is needed to study the thermal and radiative characteristics of coal-ash deposits and slags.

60769 **(ORNL/MIT—344) Analysis of coal-liquefaction separations with pseudocomponents.** Wojtowicz, R.J.; Bigot, P.C. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Jun 1982. Contract W-7405-ENG-26. 98p. NTIS, PC A05/MF A01. Order Number DE82016602.

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Three physical-property correlations and four vapor-liquid equilibrium-calculation methods were evaluated to determine which combination best characterized coal liquids vapor-liquid equilibria. Use of Wilson's correlation best predicted molecular weight and critical pressure with an average deviation (for 95% confidence) of 7.4 and 10.4%, respectively. Both the Starling and Wilson correlations were used to fit critical temperature and acentric factor within an average deviation (for 95% confidence) of 2.1 and 20.8, respectively. The Redlich-Kwong-Soave equation of state yielded the most accurate K-value predictions, with the average absolute relative deviations ranging from 5 to 50%. The Peng-Robinson equation of state was best near the critical temperature at high pressures, with average absolute relative deviations of 5 to 60%. The sensitivity of the results to pseudocomponent characterization was investigated, and recommendations for future work was done.

60770 **Primer on coal.** *Reviews of Modern Physics;* **53**: No. 4, S15-S22(Oct 1981).

The term coal is applied to a very wide range of substances. All are carboniferous solids formed over geological periods by the metamorphosis of vegetable matter under heat and pressure. Coal displays on every scale - atomic, microscopic, and macroscopic - an intrinsic heterogeneity which reflects both the natural biological variability of vegetation and the diversity of geologic histories resulting in coalification. The starting matter is chemically and physically heterogeneous - containing wood, bark, leaves, needles, pitch,

spores, algae, etc., and all their diverse chemical constituents such as resins, waxes, lignins, hemi-cellulose, cellulose, etc. Over periods ranging from 60 to 200 million years, moreover, the various coals have experienced an extremely wide range of differing geologic histories. Processes of coalification are complex and poorly understood. The transition from biological processes (e.g. decomposition mediated by microbes) to purely physical processes cannot be unambiguously reconstructed. At present, it is not possible to discuss the sructure of coals in terms of known transformations of known precursors. The carbonaceous (organic) material is composed of several distinguishable substances called macerals which are disposed in irregularly shaped domains. The nearest possible thing to a classical (pure substances) approach is to study the properties of segregated macerals, one variety at a time. The need to do this imparts some importance to the development of efficient techniques for separating and sorting macerals.

60771 **Pore strucure of coal.** *Reviews of Modern Physics;* **53**: No. 4, S23-S27(Oct 1981).

A number of important physical and chemical properties of coal are intimately connected with, and sometimes uniquely influenced by, the pore structure of coal. Among these are effects relating to adsorption, absorption, diffusion, mass transport, catalytic and combustion processes. Effective coal utilization requires a much improved understanding both in the physical description of the pore structure, and in the way that pore structure influences how chemical reactions occur for coal. As stated by Grimes, 1980, ...details of the pore structure - influence the behavior of coal more directly than does virtually any other property. This is readily appreciated with the realization that it is only through the surfaces, especially the internal pore surfaces (the integrated value of which can range from 10's to over 200 m^2/g) that the coal comes into contact with the external environment. The reactivity in coal gasification processes depends on the extent of the microporosity in coal. However, at the required elevated temperature and during the heating process, the microporosity of the coal undergoes drastic changes, with the nature of the changes significantly depending on the type of coal used. For sub-bituminous coal and lignites the elevated temperature results in the removal of volatiles in coal and consequently both an increase in average pore size of the open microporosity and the opening up of previously sealed pores. For most bituminous coals, on the other hand, much of the open porosity is lost when the coal goes through a plastic phase upon heating to gasification temperatures. Treatment of coal (e.g., addition of oxygen) during the heating process can significantly alter the porosity, and therefore can increase reactivity in the coal gasification process.

60772 **Analytical technique.** *Reviews of Modern Physics;* **53**: No. 4, S29-S52(Oct 1981).

This section is intended to pinpoint some selected analytical techniques which could be profitably applied to coal utilization and synthetic fuel production. We have selected techniques which show the most promise for providing significant information on key problems or which offer new approaches to these problem areas. Some are presently utilized by the physics community and some are under extensive development but have not been applied to coal. The complexity of coal and its derivatives imposes unusual demands on analytical techniques. The development of analytical techniques would be greatly assisted if properly selected and preserved reference coals were widely available to analysts and basic coal research groups. Analytical and basic research results would be significantly more valuable if a limited number of carefully selected, characterized and stored coals were studied so that results from different studies could be directly compared.

60773 **Catalysis.** *Reviews of Modern Physics;* **53**: No. 4, S135-S145(Oct 1981).

The development of appropriate catalysts probably provides the greatest opportunity for exerting leverage on synthetic fuel technology. The advantages of performing the necessary reactions rapidly under mild conditions of temperature and pressure are obvious. What a physicist approaching the subject for the first time should also bear in mind, however, is that the key desirable attribute of a catalyst is product selectivity. To put it quite simply, one wishes to produce a desired end product such as high octane gasoline. Catalysts that allow one to obtain that end product most expeditiously, and with the least amount of less valuable products, are most desirable. We discuss several areas of catalysis offering interesting and technologically important research opportunities. These deal with: (1) shape and size selective zeolite catalysts, especially the synthetic zeolite ZSM-5; (2) mineral matter catalytic effects in direct liquefaction; (3) surface science related to transition metal heterogeneous catalysts for synthesis gas conversion; and briefly with both; (4) catalyzed gasification of carbons and coals; and (5) denitrogenation and desulfurization catalysts. Specific research recommendations are made.

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REFER ALSO TO CITATION(S) 60719, 60735, 60831, 60832, 60835, 60836, 62035

60774 **(DOE/METC—82-47) Second annual contractors' meeting on contaminant control in hot coal derived gas streams. Proceedings.** (USDOE Morgantown Energy Technology Center, WV). 1982. 555p. (CONF-820208—). NTIS, PC A25/MF A01. Order Number DE82018281.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

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The second annual contractors' meeting on contaminant control in hot coal derived gas streams was held February 17-19, 1982, at the Ramada Inn, Morgantown, West Virginia. It was sponsored by US Department of Energy, Morgantown Energy Technology Center, P.O. Box 880, Morgantown, West Virginia 26505. All thirty-one papers have been entered individually into ERA and EDB. (LTN)

60775 (DOE/METC—82-47, pp 18-33) **Gas stream filtration for pressurized fluidized bed combustion: an EPRI perspective.** Tassicker, O.J. (Electric Power Research Inst., Palo Alto, CA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

For pressurized fluidized-bed combustion to be accepted by the electric power utility industry, gas turbine reliability must be assured, and EPA flue gas emission standards must be met. Hot flue gas entering the gas-turbine must be cleansed of particles and alkali vapors to assure turbine reliability. To meet EPA particulate emission standards of 23 ppmm (mass), either an advanced filter must be installed before the gas turbine, or a baghouse or precipitator must be installed before the stack. In this paper, the issues of particulate cleaning before the gas turbine and before the stack are examined. The case for pursuing aggressively an advanced gas-filter to operate at 900°C and 10 bar with an efficiency of 99°(+), is overwhelming. Such a filter would be preceded by a cyclone to remove 70 to 90% of the coarse ash fraction. The advantages of such a system are: attractively low particulate loading (<ppmm) into the gas-turbine, comfortably meets EPA stack emission standards, reduced pressure drop improves overall system thermal efficiency, modular factory construction and barge transportable, and obviates the bulk and cost of a large precipitator before the stack.

60776 (DOE/METC—82-47, pp 75-86) **Electrostatic granular bed filter development program.** Muller, D.J. (General Electric Co., Schenectady, NY); Boericke, R.R.; Alexander, J. 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

General Electric Company, working with EFB, Inc., has investigated the application of EFB's unique Electrostatic Granular Bed (EGB) filter to high temperature, high pressure gas cleanup. Cold flow experiments designed to provide engineering data have been completed, including tests with simulated sticky powder to demonstrate that plugging of the front face can be avoided. A theoretical performance analysis based on the unit cell model, and including electrostatic effects has been developed, and has been validated with carefully controlled laboratory experiments. Based on these laboratory experiments, a design concept for an electrostatic granular bed filter has been developed. This design concept is uti-

lized as a basis for the detailed design of two test units, one for high temperature, atmospheric pressure testing (AFB conditions) and the second for high temperature, high pressure testing (PFB conditions).

60777 (DOE/METC—82-47, pp 87-115) **Progress in high-temperature moving bed granular filter development at Combustion Power Company.** Guillory, J.L. (Combustion Power Co., Menlo Park, CA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The high-temperature moving bed granular filter program at Combustion Power Company (CPC) was started in 1977 and has included pilot testing, modeling and scale-up efforts. During 1981, the following progress was made: (1) Two 200-hour GBF tests at 1600 to 1650F were run in CPC's coal fired atmospheric fluid bed combustor system. Overall collection efficiencies of 99% were attained at around 25 to 35 Iwd pressure drop with submicron collection efficiency about 96%; (2) a finite-difference GBF collection performance computer model was completed and operationally checked out. New bench-scale static bed capture data, an improved reentrainment model and improved particle-particle physics were incorporated in the model; (3) efforts to design a practical large-scale pressurized filter from atmospheric pilot data were initiated. A modular approach was adopted using elements of roughly the same size tested at pilot scale. Single units are designed for about 30,000 ACFM each with common media lift systems serving up to 120,000 ACFM of filter capacity.

60778 (DOE/METC—82-47, pp 116-146) **Testing and verification of granular bed filters for removal of particulates and alkalies.** Lippert, T.E. (Westinghouse Electric Corp., Pittsburgh, PA); Ciliberti, D.F.; Bachovchin, D.M.; O'Rourke, R; Pirrmann, R.A.; Zenz, F.A.; Russell, R.A.; Bianchini, J. 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The Granular Shallow Bed Filter (GBF) is proposed as a device to clean particulates from Pressurized Fluidized Bed Combustion (PFBC) gas streams. The GBF is a device in which the dust laden gas pass through a shallow granular bed depositing the particulate matter on the surface of the granular media. The bed media is cleaned by a reverse flush that gently fluidizes the bed and elutriates the collected particulate matter from the system. Described herein are analyses and data that reflect on the GBF concept as it would apply to a PFBC and preliminary results of testing done on a six-element subpilot scale GBF unit. Results of systems analysis have shown an overall economic incentive for the GBF and PFBC compared to all-cyclone gas cleanup. Based on this analysis, performance goals for the GBF have been identified. A six element-24 bed subpilot scale GBF has been built and tested at both ambient and simulated PFBC conditions. Ambient flow tests were used as a basis to characterize the backflush system and evaluate candidate bed media. At PFBC conditions, the test unit was operated about 50 hours (cumulative) through 103 cleaning cycles. During the course of testing, mechanical design problems were experienced with the backflush lines and element-to-eductor dust seals. Preliminary results from the testing programs are described.

60779 (DOE/METC—82-47, pp 147-164) **Summary report II: demonstration of the feasibility of a magnetically stabilized bed for the removal of particulate and alkali.** Golan, L.P.; Goodwin, J.L.; Matulevicius, E.S. (Exxon Research and Engineering Co., Florham Park, NJ). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The purpose of the program is to demonstrate the feasibility of using a bed of magnetizable particles subjected to a magnetic field to remove the particles and alkali metal compounds found in the flue gas generated by a pressurized fluidized bed combustor (PFBC). The unique characteristics of a magnetized panel bed promote the system advantages of: high throughout rates, high particulate capture efficiency, trace metal removal, and applicability to a wide variety of coals. The key feature of this concept is the use of the magnetic field to maintain integrity of the cross-flow bed. Preliminary cold flow studies conducted at Exxon have shown that such a bed is capable of contacting the solid bed material with gas at velocities four times greater than possible in the crossflow moving bed filters without the imposed magnetic field. The advantages for the concept developed through the cold flow studies are: (1) increased throughput. The gas velocity before bed material is entrained or blown out of the bed is significantly increased because of the orientation and structuring of the bed material by the magnetic field; (2) lower pressure drop. The structuring and the orientation of the bed results in a higher void fraction and hence lower pressure drag per unit thickness of the bed when compared with a conventional moving granular bed operating at the same conditions; (3) the collection efficiency is increased significantly over conventional beds; (4) alkali metals can be picked up by non-magnetic scavengers which are admixed with the magnetic bed material.

60780 (DOE/METC—82-47, pp 165-175) **A.P.T. Dry Plate Scrubber for particulate collection at high temperature and pressure.** Calvert, S.; Yung, S.; Jain, R.; Le, T.; Brattin, H.; Duncan, M. (Air Pollution Technology, Inc., San Diego, CA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The A.P.T. Dry Plate Scrubber (DPS) uses one or more shallow, dense mobile beds of solid collector granules supported on perforated plates to remove impurities from a gas stream. A bench scale DPS was installed on a slip stream of the flue gas from an atmospheric fluidized bed combustor (AFBC) to determine the cleanup efficiency attainable at high temperature with realistic (and sticky) fly ash. The DPS column was made from 20 cm diameter (8 in. sch. 40) s.s. 310 pipe. Overall height of the DPS is 122 cm (4 ft). The DPS column has space for up to 4 jet plates. The top plate is electrostatically augmented by applying a field to polarize the collectors. Particles can be charged in a wire and plate precharger. Collector granules are 0.42 to 0.84 mm diameter alumina spheres. The collectors are stored in an overhead hopper and preheated to gas temperature before they are introduced to the DPS. The collector granules are recycled from the DPS bottom hopper to the DPS overhead hopper. Fly ash particles are shaken off the granules in the transport pipe and are carried away by the transport air. The operation of a multiple stage, bench scale DPS on hot gas from an AFBC showed that it is capable of operating at high temperatures. Particle collection efficiency has exceeded that previously attained with room temperature operation of the DPS. Electrostatic augmentation at high temperature improved the DPS efficiency. A 4-stage electrostatically augmented DPS can clean the gas to meet both the GE turbine requirements and the EPA NSPS.

60781 (DOE/METC—82-47, pp 176-199) **Acoustic agglomeration of power plant fly ash.** Reethof, G.; McDaniel, O.H. (Pennsylvania State Univ., University Park, PA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

Recent progress and some potential problems are reported on a research project investigating the agglomeration of submicron fly ash particulates. The applications of acoustic agglomeration to coal fired power plant emission clean-up and hot gas clean-up for fluidized pressurized coal combustion systems are considered. The emphasis has been on the acoustic phenomena expected to exist in large agglomeration systems at the elevated temperatures of the gases, the high acoustic intensities and the optimum frequencies. We have also studied the absorption of acoustic energy in high pressure and high temperature gases such as the products of combustion from coal fired systems in regular steam generators or pressurized, fluidized coal beds as a function of sound frequency, gas temperature pressure and absolute humidity. The indications are that at sonic frequencies (i.e. 3000 Hz) the absorption, although significant, is manageable but at ultrasonic frequencies we appear to be faced with very high absorption (on the order of 7 to 10 dB/m) which raises some serious questions about the viability of the parametric acoustic concepts as a significant enhancer of acoustic agglomeration. We have essentially completed the construction of the electrically heated 700°F, high intensity agglomerator. Check-out tests have been started. Studies have also been made on the fragility

of fly ash agglomerates from our currently operating agglomerator using cascade impactors to separate various sizes of agglomerates.

60782 (DOE/METC—82-47, pp 200-232) **Acoustic agglomeration for hot-gas cleanup in pressurized fluidized-bed combustion.** Lee, P.S.; Shaw, D.T. (State Univ. of New York at Buffalo, Amherst, NY). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

Upon completion of the DOE contract on the performance evaluation of AA for hot-gas cleanup in PFBC systems, we can draw the follow conclusions. Acoustic Agglomeration: the turbulent AA concept performs well for hot-gas cleanup in a HTHP environment. A sonic field with SPL of 160 db and a residence time of about 1 sec is usually recommended for satisfactory performance. Hydrodynamic turbulent flow enhances the rate of aerosol agglomeration and is advantageous to industrial application of AA. Comparison with conventional cyclone systems demonstrates that AA is preferable. Acoustic Generators: the concept of dirty air siren provides the suitable high-intensity sound source. The acoustic output of this device is roughly proportional to the product of flow volume and pressure drop. Employing the entire dusty hot gas to drive the DAS, the pressure can be kept at a minimal. Agglomeration Chamber: investigations reveal that the geometrical configuration of the AA chamber offers no significant differences in the acoustic gain. Consequently, simple geometry can be used to achieve virtually the same efficiency. Economic estimation: the major cost in constructing the AA system is the stainless steel required for tube sheet. A combined AA/cyclone system can be fabricated and serviced at a cost lower than the conventional cyclone/baghouse system.

60783 (DOE/METC—82-47, pp 233-251) **Hot gas cleanup using porous ceramic cross flow filters.** Ciliberti, D.F.; Smeltzer, E.E.; Keairns, D.L. (Westinghouse Electric Corp., Pittsburgh, PA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

A program is being conducted for the Department of Energy to advance the use of cross-flow porous ceramic membrane filters for the removal of particulates from hot pressurized combustion gases, such as those from a pressurized fluidized-bed combustion process or from coal gasification. The results of this program are presented in terms of removal efficiencies and operating pressure drop cycles of high pressure and temperature [1114 kPa (11 atm) and 800°C], for various porous ceramic membrane structures and blowback conditions.

60784 (DOE/METC—82-47, pp 252-260) **High-temperature ceramic filters for hot gas cleanup in pressurized, fluidized-bed combustors.** Shackleton, M.; Chang, R.; Sawyer, J.; Turner-Tamiyasu, E.; Kuby, W. (Acurex Corp., Mountain View, CA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

Advanced coal conversion processes require improved gas cleaning equipment capable of operation at elevated temperatures and pressures. We have developed filters made from ceramic felt that operate at temperatures greater than 1100°C (2000°F). Extensive tests of these filters with different dust types and at different temperatures have shown that they are capable of collection efficiencies greater than 99.99 percent with good cleanability. In recent tests at Acurex, the filters also withstood 100,000 cleaning cycles without apparent damage. System malfunction caused some problems during scaleup testing on a fine filter unit at Westinghouse (Waltz Mill, PA). These problems were corrected and design modifications were incorporated into a 15-filter unit to be tested under actual pressurized, fluidized-bed combustion (PFBC) at Curtiss-Wright (Wood Ridge, NJ). In a preliminary economic anlaysis, a commercial-scale ceramic filter for a 660-MWe PFBC plant compared favorably with other potential hot gas cleaning devices.

60785 (DOE/METC—82-47, pp 261-281) **Electrocyclone development program.** Boericke, R.R.; Giles, W.G.; Kallio, G.; Dietz, P.W.; Kuo, J.T. (General Electric Co., Schenectady, NY). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The electrocyclone is an adaptation of a conventional cyclone in which a high-voltage corona electrode is used to charge the dust particles and to provide an electric field which augments the inertial forces driving particles to the cyclone wall. Since the electric field forces do not decrease as the cyclone is made larger, a large (6 to 10 ft) electrocyclone can achieve collection efficiencies comparable to a one- or two-foot diameter conventional cyclone. In this paper, recent progress under the Electrocyclone Development Program is reviewed. Significant results include confirmation of cyclone scaling laws, high dust loadings are described, in which the effect of space-charge on electrocyclone performance is determined. The current status of the Electrocyclone Development Program is also summarized.

60786 (DOE/METC—82-47, pp 282-288) **High temperature high pressure electrostatic precipitator.** Kumar, K.S. (Cottrell Environmental Sciences, Somerville, NJ). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

This article presents the status of ongoing DOE contract to demonstrate the operation of high temperature high pressure electrostatic precipitator for particulate removal from hot gas stream following the PFBC at Curtiss-Wright. Engineering philosophy utilized for the fabrication of this ESP has been evolutionary in nature, with lessons from past pilot plant projects guiding the choice of workable designs. Concepts included are: oscillation free discharge electrodes, temperature controlled high voltage insulators, free expansion of support structures and an ash dislodgement system comprised of electrode rappers and sonic horn. The ESP is presently in the procurement phase, scheduled for installation at Curtiss-Wright in June, 1982. Some parametric testing is also planned at the DRI HTHP ESP test facility to evaluate several discharge electrode designs for a variety of operating conditions differing in temperature and pressure. Electrostatic precipitators are proven devices for treating large gas volumes in the power and chemical process industries. ESP's also have the advantage of performing at high collection efficiency at extremely low pressure drops. ESP's, by their intrinsic nature, are non-barrier devices and are least prone to plugging problems. However, ESP's for PFB conditions have been demonstrated only by small scale and need prototype hardware development for use in PFB application.

60787 (DOE/METC—82-47, pp 289-299) **High-temperature, high-pressure electrostatic precipitator.** Rinard, G.; Yamamoto, T.; Armstrong, J. (Denver Research Inst., CO). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The electrostatic precipitator (ESP) is being considered as a strong candidate device for final particle cleanup in pressurized fluidized bed combustion (PFBC) power plants (Rinard et al., 1981). ESP's offer several potential advantages over filtration and inertial devices at high temperature-high pressure (HTHP) conditions. Because there is little flow restriction in an ESP, the pressure drop is extremely low. Because of their flow-through design, ESP's exhibit the potential for little or no clogging that might be experienced in filtration type devices. Inertial devices lose efficiency at reduced loads because of the reduced gas velocity; the collection efficiency of ESP's improve under such conditions. Similarly, when inertial devices are scaled up to full size, there is a corresponding loss of efficiency due to the reduction of inertial forces. Electrostatic precipitators, on the other hand, can be scaled up without any reduction in efficiency. A particularly important advantage of ESP's is their potentially high collection efficiency. Conventional utility and industrial ESP's exhibit high collection efficiencies down to the submicron particle size region. Therefore, the ESP may be one of the few hot gas cleanup devices capable of meeting EPA's New Source Performance Standards for particles without adding a final control device after the turbine. Under the sponsorship of, initially, the Environmental Protection Agency and, presently, the Department of Energy, the Denver Research Institute has designed, fabricated and installed a pilot scale HTHP-ESP test facility

for performing basic research on the use of an electrostatic precipitator for hot gas cleanup.

60788 (DOE/METC—82-47, pp 300-311) **Instrumentation for coal derived hot gas streams.** Anderson, R.J.; Kovach, J.J. (Morgantown Energy Technology Center, WV). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

A variety of real time monitors are available for the chemical characterization of both gases and particles in a hot gas stream. These instruments will be field tested in FY 83 on various METC pilot- and bench-scale coal conversion units. In-situ and on-line monitors for physical characterization of hot gas stream particles are promising, but not yet proven in field tests. The most pressing need in this area is for field tests to evaluate extant devices so that the need for further development can be assessed. All of the instruments are sophisticated research tools and are not currently in a state that plant managers could use for unattended process monitors. Successful in-situ monitors will require optical windows to provide access to the process stream. Contamination of these windows is likely to severely affect the performance of the instruments. One of the restrictions on window design is that the amount of purge gas used to maintain clean windows should not represent a significant portion of the total process flow. While in-situ and on-line devices offer promise for real time monitoring of the particles in a process stream, the currently accepted methods for particle characterization are based on extractive sampling techniques. Such techniques must be used to verify the performance of real time devices and to provide confidence in their data.

60789 (DOE/METC—82-47, pp 465-478) **Alkali control in PFB combustion systems.** Boericke, R.; Luthra, K.; LeBlanc, O.; Zarchy, A. (General Electric Co., Schenectady, NY). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

General Electric is currently investigating two promising concepts for removal of corrosive alkali vapor from PFB combustion gases: surface ionization/electrostatic collection, and adsorption. In this surface ionization concept, the high temperature combustion gases are passed over a surface having a high work function which selectively ionizes the alkali species. The ionized alkali is then collected electrostatically on a cooled electrode biased with respect to the grounded ionizing surface. The concept has been demonstrated as an alkali measuring device and its application as an alkali scrubber is currently under investigation. The results of preliminary experiments will be reviewed and discussed. The GE alkali adsorption work is based on the generation of an adsorbent smoke of sub-micron particles by combustion of liquid chlorides of aluminum, silicon or other metals. Work to date has focused on measurements of alkali adsorption at high temperature using real-time measurement of weight gained by activated bauxite when exposed to varying concentrations to various alkali species. Experimental results for several alkali compounds have been analyzed and are shown to correlate with the B.E.T. adsorption isotherm theory.

60790 (DOE/METC—82-47, pp 479-489) **A.P.T. Dry Plate Scrubber for alkali vapor control.** Calvert, S.; Yung, S.; Amladi, P. (Air Pollution Technology, Inc., San Diego, CA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The A.P.T. Dry Plate Scrubber (DPS) uses one or more shallow, dense mobile beds of solid granules supported on perforated plates. By selecting suitable granules and sorbents, it is capable of both particle and vapor collection. Sorption rate and efficiency experiments were performed with diatomaceous earth, activated bauxite, dolomite, alumina, and zirconia beads. Results showed that diatomaceous earth and activated bauxite can capture over 98% of sodium vapor with a bed contact time of 0.165 s. The sodium capture efficiency of dolomite, alumina, and zirconia beads was low. Sorbent size, bed type and gas velocity have no significant effect on sodium removal as long as bed contact time remains the same. Moisture in the gas stream improved sodium capture efficiency. However, in the presence of moisture, chloride was evolved by bed. Various physical and chemical pretreatment of sorbents were carried out and did not result in any beneficial effect. The sodium capture efficiency for diatomaceous earth decreased from over 98% when sodium content of the sorbent was 5 mg/g sorbent to about 86% for sodium content of 50 mg/g. The preliminary experiments on alkali vapor control with the Dry Plate Scrubber shows that PFBC turbine requirements can be met by one or two stages of alkali sorption. The sorbent capacity for alkali is so high that stationary bed(s) can be used and need be replaced only after a long time of exposure.

60791 (DOE/METC—82-47, pp 490-505) **Removal of alkali vapors by a fixed granular-bed filter using activated bauxite as a filter medium.** Lee, S.H.D.; Johnson, I.; Myles, K.M.; Jonke, A.A. (Argonne National Lab., IL). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

Activated bauxite has been evaluated as a filter medium for removing gaseous alkali compounds from a gas stream closely simulating flue gas generated in a pressurized fluidized-bed combustor. In experiments with a laboratory-scale fixed granular-bed filter, the sorption behavior and performance of activated bauxite for NaCl vapor removal at 800 and 905°C and 10 atmospheres have been studied. Greater than 99.8% efficiency of NaCl vapor capture was achieved. The NaCl vapor was found to be captured by activated bauxite essentially as a form(s) of sulfate. The captured sodium sulfate(s) could be readily removed from activated bauxite by a simple water-leaching method, indicating the possibility of regenerating activated bauxite for reuse. The mechanism of NaCl-vapor sorption by activated bauxite is discussed.

60792 (DOE/METC—82-47, pp 506-527) **Alkali control in fluid bed combustion systems by kaolin addition and granular bed filtration.** Cooper, J.L. (Combustion Power Co., Menlo Park, CA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

Reactive alkalis in fuels can be converted by available aluminum and silicon in Fluid Bed Combustion systems to form alkali aluminosilicates, which are typically inert solids at combustion conditions. Adding selected aluminosilicates to the combustor, the converted alkalis can be removed as particulates by hot cyclones and the Granular Bed Filter (currently under development) in the hot gas cleanup subsystems. Tests have recently been completed at Combustion Power Company on the atmospheric pressure subpilot unit, which fired Illinois No. 6 coal and produced 2000 lb/hr of cleaned combustion gases at nominally 1450°F. The tests included the addition of a readily available kaolin material as the aluminosilicate source as well as the suppression of sulfur with dolomite. More than 99% of the alkalis were removed from the system and the fraction of soluble alkalis decreased upon addition of the kaolin. However, total alkali contents of the cleaned gas streams upon addition of kaolin were virtually identical (within measurement errors) to those measured in tests with dolomite addition only, at 0.23 ppM Na and 0.52 ppM K. It appears that this coal contains sufficient Al and Si to convert the alkalis to nearly the maximum amount of alkali aluminosilicates. From thermodynamic equilibrium calculations, the low chloride content of the coal prevents complete conversion of the alkalis to solid aluminosilicates and a small fraction exists in the vapor form, which can pass through the Granular Bed Filter to downstream components. At 10 atmospheres, the penetration of total alkalis through the Granular Bed Filter is projected to be nominally 0.15 ppmw of which 87% would be as solid alkali aluminosilicates. The projected reactive alkali content of the pressurized clean gas stream (i.e., vapors) would be less than 0.02 ppM by weight.

60793 **(DOE/PC/30246—1237) Experimental investigation and predictive modeling of the adsorption of polycyclic aromatic hydrocarbons from water onto activated carbon. First annual report, September 1, 1980-October 31, 1981.** Walters, R.W.; Luthy, R.G. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering). Jul 1982. Contract FG22-80PC30246. 208p. NTIS, PC A10/MF A01. Order Number DE82020723.

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Eleven of the sixteen polycyclic aromatic hydrocarbons (PAH) which appear on the US Environmental Protection Agency priority pollutant list have been investigated with respect to adsorption onto activated carbon. Adsorption characteristics were examined in terms of PAH molecular and physicochemical properties. The partitioning behavior of PAH was investigated by generating adsorption isotherm data for eleven PAH from water onto Filtrasorb 400 activated carbon at 25°C using batch shake testing. An evaluation of the Henry's Law, Langmuir, BET, Freundlich and Redlich-Peterson adsorption isotherm equations indicated that the Langmuir equation most appropriately represents the data. Fitting the data to two linearized forms of the Langmuir equation provides estimates of the Langmuir parameters b and q^0 which apply over different equilibrium concentration (c/sub e/) ranges. The products of the parameters bq^0 obtained using the low c/sub e/ linear form of the Langmuir equation approximate Henry's Law adsorption constants. These values range from 2390 mg/g per mg/l for naphthalene to 326,000 mg/g per mg/l for chrysene. The parameter q^0 obtained using the high c/sub e/ linear form of the Langmuir equation reflects limiting adsorption capacity. These values range from 580 mg/g for naphthalene to 14.7 mg/g for benz(a)anthracene. The high c/sub e/ and low c/sub e/ capacity terms (q^0 and bq^0, respectively) were further correlated with several molecular and physicochemical parameters which have been proposed to explain chemical and physical properties of PAH. Correlations which are presented here provide an understanding of the behavior of PAH in industrial process and treated wastewaters, and will assist the engineer or scientist in assessing the design of treatment systems for PAH removal.

60794 **(EPRI-CS—2359) Dowa process demonstration: Shawnee test facility. Final report.** Puschauer, E.J.; Veitch, J.D.; Jackson, S.B.; Smith, D.B.; Treshier, J.R.; Propp, W.A. (Tennessee Valley Authority, Muscle Shoals, AL (USA); UOP, Inc., Des Plaines, IL (USA)). Apr 1982. 321p. NTIS (US Sales Only). Order Number DE82904643.

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The Dowa flue gas desulfurization process, an aluminum-based double alkali process that uses forced oxidation, limestone neutralization, and produces gypsum, was evaluated at a 10-MW scale on a coal-fired boiler at the EPA Shawnee test facility. Although SO_2 removal with a Turbulent Contact Absorber was less than expected, SO_2 removal efficiencies of 90% were obtained at flue gas velocities of 7 to 11 ft/sec and liquid-to-gas ratios of 80 to 95 gal/kaft^3 by using an adsorber containing 6 to 9 feet of rigid packing with a pressure drip of 2 to 9 inches H_2O. Efficient air-liquid contact in the in-loop forced oxidation tank and control of absorbent basicity were essential to efficient SO_2 removal. No scaling or corrosion of high-alloy or organic-coated materials was observed during the six-month test. Fly ash appeared to have served as an oxidation promoter, a function normally served by a metal catalyst. A product consisting of over 99% gypsum filterable to over 80% solids was produced. Further evaluation is needed to completely define Dowa process operation on coal-fired boilers.

60795 **(PB—82-191180) Research at the NBRI into the utilization of PFA.** Kruger, J.E. (National Building Research Inst., Pretoria (South Africa)). 1982. 20p. NTIS, PC A02/MF A01.

The paper deals with research that has been carried out at the National Building Research Institute into the utilization of pulverized fly ash (PFA) as a building material. It mainly describes the research into the use of the material as a substitute for a portion of the portland cement or the sand in concrete. Data in connection with the use of PFA for the manufacture of bricks, low-density aggregate and autoclaved gas concrete are also briefly mentioned.

60796 **(PB—82-210089) Resource and potential reclamation evaluation: White Tail Butte study area, Little Powder River Coal Field; emira (energy mineral rehabilitation inventory and anlaysis) report no. 13. Final report 1977-81.** (Bureau of Reclamation, Billings, MT (USA)). May 1981. 381p. NTIS, PC A17/MF A01.

Resources are assessed for reclamation potential at the White Tail Butte Study Site, 35 miles north of Gillette in Campbell County, Wyoming. Site specific analyses were conducted for climate, physiography, geology, coal resources, overburden, soils, vegetation, and hydrology. It was determined that special consideration should be given to: (1) stability of landscape, (2) restoration of water resources, (3) erosion control, and (4) vegetation.

60797 **(SAND—82-1191) Physical modeling of tailings dams using centrifuge simulation techniques.** Sutherland, H.J.; Rechard, R.P. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01. Order Number DE82022240.

The development of the phreatic surface in a stable tailings dam is investigated by using centrifuge simulation techniques and analytical techniques. The centrifuge simulations, conducted on an 8 m (25 ft) radius machine, uses a modeling-of-models approach to determine the effects of scaling and model construction on the development of the phreatic surface. The analytical and numerical techniques include predictions of the effects of scaling on the development of the phreatic surface, determination of the location of the steady-state phreatic surface in a full scale prototype dam, and determination of the stability of a prototype dam in terms of the conventional factor-of-safety. While these analyses indicate that there should be no scaling effect on the steady-state phreatic surface, tests run at over 100 g scaling show a rise in the phreatic surface with increasing g load. Numerical predictions of the steady-state phreatic surface compare well with data taken below 100 g scaling.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 60756, 60813, 60819, 60830, 60843, 60846, 60847, 62028, 62035

60798 **(NP—2906043) Plant-growth response to various combinations of mulches and spoil substrates on a Walker County, Alabama, surface coal mine.** Cross, E.A.; Gabrielson, F.C.; Hughes, T.H. (Alabama Univ., University (USA). School of Mines and Energy Development). May 1982. 35p. NTIS, PC A03/MF A01. Order Number DE82906043.

In 1978-1979, Walker County, Alabama, was the site of an experiment designed to assess plant growth and soil erosion. The experiment utilized 6 mulch treatments applied to each of 3 coal surface mine substrates. The mulches (wood fiber, hardwood bark, pine bark, waste compost, paper-slag, and no mulch application) were randomly combined with either A + B horizon soil, shale, or a mixture of the two. The resulting 18 plots were replicated on two slopes (N-S). A standard seed-fertilizer regimen was applied to all plots. Plots were read in June and October 1979 for species composition, density, and plane cover. Overall grass growth, as measured by plane cover, was best on mixed substrate, and growth was not significantly different between shale and topsoil plots. Density and cover provided by volunteer species varied according to slope, substrate, and mulch combinations. Overall, numbers of spoil arthropods did not show great differences according to slope or substrate.

60799 **(ORNL/TM—8215) Coal pile leachate treatment.** Davis, E.C.; Kimmitt, R.R. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01. Order Number DE82021112.

The steam plant located at the Oak Ridge National Laboratory was converted from oil- to coal-fired boilers. In the process, a diked, 1.6-ha coal storage yard was constructed. The purpose of this report is to describe the treatment system designed to neutralize the estimated 18,000 m^3 of acidic runoff that will be produced each year. A literature review and laboratory treatability study were conducted which identified two treatment systems that will be employed to neutralize the acidic runoff. The first, a manually operated system, will be constructed at a cost of $200,000 and will operate for an interim period of four years. This system will provide for leachate neutralization until a more automated system can be brought on-line. The second, a fully automated system, is described and will be constructed at an estimated cost of $650,000. This automated runoff treatment system will ensure that drainage from the storage yard meets current National Pollutant Discharge Elimination System Standards for pH and total suspended solids, as well as future standards, which are likely to include several metals along with selected trace elements.

60800 **(PB—82-189515) Resource and potential reclamation evaluation: White Tail Butte study area, Little Powder River coal field; EMIRA (energy mineral rehabilition inventory and analysis) report No. 13. Summary report 1977-81.** (Bureau of Land Management, Billings, MT (USA). EMRIA Program). May 1981. 30p. NTIS, PC A03/MF A01.

The report assesses resources for reclamation potential at the White Tail Butte study site, 35 miles north of Gillette in Campbell County, Wyoming. Site Specific analyses were conducted for climate, physiography, geology, coal resources, overburden, soils, vegetation, and hydrology. It was determined that special considerations should be given to: stability of landscape, restoration of water resources, erosion control, and vegetation.

60801 **Trace elements from coal combustion - atmospheric emissions: a bibliography.** Harter, P. London, England; IEA Coal Research (1982). 36p. (ICTIS-BIB—2). IEA Coal Research, 14-15 Lower Grosvenor Place, London, England SW1W 0EX.

In May 1979 IEA Coal Research, Technical Information Service published a critical review of the literature on atmospheric emissions of trace elements from coal combustion by M.Y. Lim (report number ICTIS-TR--05). In the above publication a review of the literature relating to trace elements in coal combustion, including data on trace element concentrations in coal, is presented from the viewpoint of atmospheric pollution. Comparisons are also made with atmospheric emissions from other sources. Environmental effects and potential health hazards are discussed. The literature on radioactive emissions and trace element accumulation around power plants is also reviewed. A brief summary is given of types of equipment used for particulate control in power plants. It is concluded that the importance of pollution from coal combustion will depend upon the establishment of regulations for emission control and on how far power plants comply with these regulations. Although the above report has proved to be a popular and useful introduction to the subject it is not possible to update it by preparing a second edition at this time. This bibliography has therefore been compiled to supplement the reference list in the report and bring it up to date.

60802 **CO_2 emissions: comparisons of the use of coal for energy production by various routes.** *Reviews of Modern Physics;* **53**: No. 4, S147-S159(Oct 1981).

We compare various coal utilization methods as sources of carbon dioxide. Because of sensitivity to engineering detail, differences in carbon utilization efficiency derived indicate only general trends. A second fundamental problem is the fact that the fuel value of the products of coal use are not equal by several measures, thermodynamic but also non-technical - e.g., the societal values of electricity vs. natural gas or synthetic gasoline. We have disregarded what many have rightly considered important in energy analysis. We restrict our discussion to quantitative assessments of the CO_2 outputs of the technologies considered. We do not broach the subject of possible effects of CO_2 from any sources. Our discussion is relevant to an assessment of the trade-offs and penalties associated with various fuel strategies which could be adopted; and should be viewed as providing a method for quantitative analysis of this one limited aspect, with the primary objective of delineating the physical basis, and research avenues, pertinent to CO_2 release. The analysis leads to some conclusions about relevant research directions: first, the incorporation of source carbon into a synthetic fuel product (i.e., the desirable complement of CO_2 effluent) increases directly as the thermal efficiency of a process for fuel synthesis increases. Second, it is possible to substantially reduce CO_2 emissions from synthetic fuel plants by providing a non-fossil source of process energy. We corroborate previous estimates used in the CO_2-effects studies, that conversion of coal to a synthetic fuel and utilizing that fuel, gives a net CO_2 production of about twice that for the same energy output using a comparable natural fossil fuel.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 62189

60803 **(NP—2906031) Assessment of geologic factors controlling the economic recovery of Alabama deep-basin lignite.** Mancini, E.A. (Alabama Univ., University (USA). School of Mines and Energy Development). Jul 1981. 87p. NTIS, PC A05/MF A01. Order Number DE82906031.

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The primary objective of this research has been the assessment of the geologic factors controlling the economic recovery of the deep-basin lignite in the Alabama Coastal Plain. The objective has been achieved by determining the thickness and quality of the lignite resource and the lithology of the strata overlying the lignite beds. Results of the study are presented. Two coreholes were drilled in Choctaw County, Alabama, to evaluate the deep-basin lignite resource in southwest Alabama. The deep-basin Oak Hill lignite core is of a higher quality than the near-surface lignite. The deep-basin lignite has an average calorific value on a moisture-free basis of 12,680 Btu/lb. The deep-basin Tuscahoma lignite is not of as high a quality as the deep-basin Oak Hill lignite. (DMC) The main Oak Hill lignite bed is between 2 to 11 feet thick in coreholes and oil and gas wells studied from Choctaw County. The overburden thickness increases from less than 50 feet in northern Choctaw County to over 2000 feet in the southern part of the county. The hypothetical deep-basin Oak Hill lignite resource in Choctaw County is about 2.3 billion short tons. The hypothetical deep-basin lignite available in southwest Alabama may exceed 3 billion short tons. In situ low-Btu gasification without any transportation is presently the most feasible method of recovering the energy stored in the deep-basin lignite in southwest Alabama. In situ liquefaction is potentially the recovery method of the future for the deep-basin Oak Hill lignite. (DMC)

0120 Mining

REFER ALSO TO CITATION(S) 61656

60804 **(DOE/ET/11268—18) Feasibility of designing open-cast equipment with increased selective-handling ability. Final report.** (Skelly and Loy, Harrisburg, PA (USA)). Jan 1982. Contract AC01-79ET11268. 132p. NTIS, PC A07/MF A01. Order Number DE82010509.

This report has investigated a wide variety of topics relating to inimical overburden materials. These topics range from research into the occurrence of inimical materials in regional stratigraphy to comparative cost analyses of overburden handling with open cast equipment. The results of this investigation are summarized. The purpose was to identify operational methods or equipment modifications that have the potential to obviate cost increases resulting from the selective handling of inimical materials. As mentioned above, there is no shortage of operational methods available. The use of an operational method is limited only by economics. Frequently, the economic limits of an operational method can be related directly to the machine's physical specifications. The report contains a considerable amount of information about the various kinds of surface mining equipment: Sizes available and specifications, comparative evaluations (specifically for selective handling of overburden), and the population of each in the US. The requirements for the selective handling of inimical material result from regulations based on surface mining acts. Three examples are examined.

60805 **(DOE/ET/12462—1) Development of a system for high-speed drilling of small-diameter roof bolt holes. Final technical report as of April 1, 1982.** Bonge, N.; Ozdemir, L. (Colorado School of Mines, Golden (USA). Earth Mechanics Inst.). Apr 1980. Contract AC01-76ET12462. 245p. NTIS, PC A11/MF A01. Order Number DE82017787.

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This investigation had as its purpose the development of a new drilling technology capable of producing a roof bolt hole smaller than that which is typical of a conventional rotary-mechanical drill, while at the same time increasing the penetration rate. Re-

ducing the hole size promotes the use of resin bolting as the quantity of materials used per hole is reduced, thereby lowering the cost of the operation. As resin bolting is widely recognized as being a safer method of roof control than mechanically anchored bolts, the overall safety of mining is improved. A system utilizing high velocity water jets in conjunction with a rotary-mechanical bit was developed and refined, with major emphasis placed upon hybrid-bit design and high-pressure rotary-sealing techniques. This required the development of theory and design models, as well as the system engineering itself. The WATER JET MECHANICAL system developed began with an experimental surface drill, followed by the development of a more advanced and reliable above-ground system and, finally, the development of an underground unit. Penetration rates in some rock types far exceeded those demonstrated by conventional rotary-mechanical drills and by pure jet drilling systems, typically by a factor of two or more. Bit thrust and torque were reduced by more than four to one compared to rotary-mechanical systems, and bit life increased by seventy-five times in even the hardest and most abrasive of partially metamorphosed sandstone. An analysis of the drilling data indicates that cost of the bolting operation may be reduced by 13 to 30% by the use of water jet mechanical systems and that the technology, which is currently in limited commercial use, may represent an important advance in mining technology.

60806 **(DOE/ET/14259—T1) Types and causes of haulage-system delays out by the face in US underground coal mines. Final report.** Douglas, W.J.; Kiefer, J.A.; Kohler, J.L. (Ketron, Inc., Wayne, PA (USA)). Apr 1982. Contract AC01-79ET14259. 135p. NTIS, PC A07/MF A01. Order Number DE82021180.

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This report summarizes the results of a study to characterize and quantify the occurrence and impact of outby haulage delays on production in US underground coal mines. An instrumentation system employing digital data loggers was used to acquire data for over 500 belt shifts in six mines. Observers collected section production data and section delay data to supplement the haulage database. A statistical data reduction system was applied to develop statistics on failure rates and delay lengths. A production impact model was developed and applied to analyze the effect of reducing delays and implementing engineering changes to the haulage systems. Analytical investigations of the relationship between delays and mine characteristics were conducted, and the impact of feeder-breakers and bunkerage, and the addition of longwall units to existing mines was investigated. The study provides a quantitative information base on underground belt haulage delays for use by mining companies and mining researchers.

60807 **(NASA-CR—161959) Detection of the coal roof interface by use of high pressure water. Final report.** (Missouri Univ., Rolla (USA)). 1981. 55p. NTIS, PC A04/MF A01.

A device whereby water jets can be used to detect the interface between coal and the overlying roof rock is described. Once this identification is made this distance can be measured using instruments such as the autofocus systems recently developed in the photographic industry. Experiments carried out show that the device can discriminate between coal and rock at coal thicknesses up to 8 inch. An autofocus system was examined which indicates accuracies of better than 0.1 inches.

60808 **(NASA-CR—161960) Baseline studies on the feasibility of detecting a coal/shale interface with a self-powered sensitized pick. Final report.** Anderson, G.R. II. (Wyle Labs., Huntsville, AL (USA)). Feb 1981. 98p. NTIS, PC A05/MF A01.

The feasibility of utilizing a sensitized pick to discriminate between cutting coal and roof material during the longwall mining process was investigated. A conventional longwall mining pick was instrumented and cutting force magnitudes were determined for a variety of materials, including Illinois 6 coal, shale type materials, and synthetic coal/shale materials.

60809 **(NASA-CR—161961) Development of sensitized pick coal interface detector system. Final report.** Burchill, R.F. (Shaker Research Corp., Ballston Lake, NY (USA)). 1982. 68p. NTIS, PC A04/MF A01.

One approach for detection of the coal interface is measurement of pick cutting loads and shock through the use of pick strain gage load cells and accelerometers. The cutting drum of a long wall mining machine contains a number of cutting picks. In order to measure pick loads and shocks, one pick was instrumented and telemetry used to transmit the signals from the drum to an instrument-type tape recorder. A data system using FM telemetry was designed to transfer cutting bit load and shock information from the drum of a longwall shearer coal mining machine to a chassis mounted data recorder. The design of components in the test data system were finalized, the required instruments were assembled, the instrument system was evaluated in an above-ground simulation test, and an underground test series to obtain tape recorded sensor data was conducted.

60810 **(NASA-CR—168393) Underground coal mining section data. Final report.** Gabrill, C.P.; Urie, J.T. (Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1981. 151p. NTIS, PC A08/MF A01.

A set of tables which display the allocation of time for ten personnel and eight pieces of underground coal mining equipment to ten function categories is provided. Data from 125 full shift time studies contained in the KETRON database was utilized as the primary source data. The KETRON activity and delay codes were mapped onto JPL equipment, personnel and function categories. Computer processing was then performed to aggregate the shift level data and generate the matrices. Additional, documented time study data were analyzed and used to supplement the KETRON databased. The source data including the number of shifts are described. Specific parameters of the mines from which there data were extracted are presented. The result of the data processing including the required JPL matrices is presented. A brief comparison with a time study analysis of continuous mining systems is presented. The procedures used for processing the source data are described.

60811 **(NASA-CR—168429) Psycho-social aspects of productivity in underground coal mining.** Akin, G. (Jet Propulsion Lab., Pasadena, CA (USA)). Oct 1981. 91p. NTIS, PC A05/MF A01.

The psychosocial aspects of productivity in underground coal mining were investigated. The following topics were studied: (1) labor productivity in deep mines and the explanations for productivity changes; (2) current concepts and research on psychosocial factors in productivity; (3) a survey of experiments in productivity improvement (4) the impact of the introduction of new technology on the social system and the way that it accomplishes production (5) a clinical study of a coal mining operation, model described how production is actually accomplished by workers at the coal face; and (6) implications and recommendations for new technology design, implementation and ongoing management.

60812 **(NP—2906079) Wyoming coal mining. A wage and employment survey, 1982.** (Wyoming Dept. of Labor and Statistics, Cheyenne (USA)). Apr 1982. 37p. Wyoming Department of Labor and Statistics, Hathaway Building, Cheyenne, WY 82002.

The Wyoming Department of Labor and Statistics initiated a wage and employment survey of the State's coal mining industry during the first quarter of 1982. The survey was designed to update the statistics obtained in the 1979 survey of Wyoming's coal mines. Specifically, data were collected to: (1) estimate the number of workers in selected occupational categories; (2) determine the average straight-time hourly wage in each occupational category; (3) determine the number of workers covered by a collective bargaining agreement in each occupational category; (4) review the employer contributions to employee fringe benefit programs; (5) establish bench mark data for Wyoming's underground coal mines.

60813 **(PB—82-187139) Environmental instrumentation in mining air and water. Open file report Aug 80-Aug 81.** Moore, R.C.; Opper, N.J.; Paul, M.D.; Kort, R.L. (Hittman Associates, Inc., Englewood, CO (USA)). 28 Aug 1981. 336p. NTIS, PC A15/MF A01.

The U.S. Bureau of Mines contracted a study to review the air and water monitoring requirements of five Federal environmental acts (the Federal Water Pollution Control Act, the Safe Drinking Water Act, the Clean Air Act, the Surface Mining Control and Reclamation Act, and the Resource Conservation and Recovery Act) and to compile information on currently available monitoring instruments. A literature review of the acts and the associated regulations was conducted to determine applicability to the mining industry as well as any air and water monitoring requirements. In addition, an industry search and literature review was performed to assess the instrumentation available to comply with the monitoring regulations. Based on this research, the instruments are classified by general applicability to air, surface water, or ground water monitoring, then cataloged by monitoring parameters. A discussion is provided on recommended and innovative monitoring techniques.

60814 **(PB—82-191701) Productivity and safety data for 535 coal mines, 1975-79. Data file.** Siskind, F.; Spiegelman, D. (Assistant Secretary for Policy, Evaluation, and Research (Labor), Washington, DC (USA)). 1979. mag taep. Source tape is in EBCDIC character set. Tapes can be prepared in most standard 7 or 9 track recording modes for one-half inch tape. Identify recording mode desired by specifying character set, track, density, and parity. Call NTIS Computer Products if you have questions. Price includes documentation, PB82-191693.

The first ten files contain Mine Safety and Health Administration raw data for the period 1975-1979 covering address and employment at each mine and accident and injury records. The last file is a SAS data set used in the report 'The Effects of Mine Safety and Health Administration Enforcement on the Cost of Underground Coal Mining.'.

60815 **(PB—82-202748) Design of a portable gas analyzer for monitoring during mine fires. Open file report (final) 27 Jun 75-1 Apr 78.** Bossart, C.J. (Mine Safety Appliances Co., Pittsburgh, PA (USA)). 10 May 1978. 55p. NTIS, PC A04/MF A01.

The design and fabrication of an engineering model and three prototypes of a portable gas analyzer and sampling system is described. The design provides a battery operated system that will indicate the degree of explosivity of return air and in the air beyond the seal while fighting, sealing, and quenching a mine fire. Performance tests, design criticisms, and recommendations for designs are included.

60816 **(PB—82-205725) Design and testing of joining sleeves for trailing cable ground and pilot wires. Open file report Jun 77-Jul 79.** Frank, W. Jr. (Burndy Corp., Norwalk, CT (USA)). Aug 1979. 122p. NTIS, PC A06/MF A01.

The purpose of this work was to develop a ground and pilot connector that will significantly improve mine trailing cable splice performance. The connector design includes connectors for splicing ground and pilot conductors. A distinction is made between connectors suitable for splicing round and flat ground and pilot conductors. A discussion on the suitability of round cable for trailing cable applications is included. A field test was conducted to confirm ground and pilot connector laboratory data. The tests proved the viability of the connector designs and recommended installation techniques in a mine environment are included.

60817 **(RR—151-Pt-1) Modelling of semiflexible conveyor structures for coal-face steering investigations. Part 1: spatially discrete models.** Edwards, J.B. (National Coal Board); Wolfenden, R.A. (Sheffield Univ. (UK)). Apr 1981. 35p. NTIS, PC A03/MF A01.

The coal-cutting machine shown is of the ranging-drum shearer type. The machine both cuts the coal from the solid face as it proceeds along the face and simultaneously loads the product onto the scraper-chain conveyor. This operation is aided by the spiral vanes around the rotating drum periphery upon which the cutting picks are mounted. The scraper-chain conveyor also has more than a single function: it not only conveys the cut product to the face-end but, because of the robust construction of its structure, it also provides a comparatively smooth track upon which the power-loader rides. Mathematical models of the steering system and the overall process are presented. Examples of predicted behavior are given.

60818 **(RR—152-Pt-2) Modelling of semiflexible conveyor structures for coal-face steering investigations. Part 2: spatially continuous models.** Edwards, J.B. (Sheffield Univ. (UK)). Apr 1981. 25p. NTIS, PC A02/MF A01.

A linear model of a flexible conveyor used on longwall coalfaces and designed to permit vertical floor undulations to be followed is presented along with a continuous elastic beam model. Predictions of the multipass system stability using the beam model are discussed.

60819 **(TVA/ONR/WR—82/9) Methodologies for assessing surface mining-impacts. Final TVA report.** Betson, R.P.; Bales, J.; Deane, C.H. (Tennessee Valley Authority, Norris (USA). Office of Natural Resources). Dec 1981. 107p. NTIS, PC A06/MF A01. Order Number DE82905980.

The development, validation, and potential applications of a mathematical model developed by the Tennessee Valley Authority are described in this report. The model is particularly suited for the planning activities associated with the determination of the effects of land use change, particularly surface mining, on the water resource. The model was developed as a series of submodels which may be applied either separately or in concert, depending on the particular application. Components include TVA-HYSIM, a model for simulating changes to streamflow volumes and peaks, a suspended sediment model, and a water chemistry component. Validation tests of each of these components is presented. Procedures for applying these models to determine the probable hydrologic consequences of surface mining at a particular site are presented. Methodologies are also presented which can be used to assess the probable cumulative impacts of a number of surface mines in a particular basin.

60820 **Hydraulic borehole mining.** Evers, J.L.; Knoke, G.S. New York, NY; American Society of Mechanical Engineers (1981). 12p. American Society of Mechanical Engineers, 345 E 47th Street, New York, NY 10017.

From Energy sources technology conference and exhibition; Houston, TX, USA (18 Jan 1981).

The Department of Energy is currently funding a program to develop a borehole mining system that accesses the mineral seam through a small hole drilled through the overburden, remotely crushes the material with a high pressure water jet, and then transports it in a slurry to the surface. The system has been tested in coal seams, uranium deposits, oil sand, and phosphate ore. This paper reviews the development of the borehole tool, the assessment of its present and projected production capability, and briefly describes related studies being supported by the Department of Energy to improve the efficiency of the borehole mining system.

60821 **(NP—2902971) Annual report of Hard Coal Mining Association for 1979.** (Steinkohlenbergbauverein, Essen (Germany, F.R.)). [nd]. 121p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82902971.

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Developments in the world energy market require the restructuring of the energy economy, where hard coal will have a particular role to play, in making an increased contribution to our energy supplies in the future. German hard coal mining is therefore attempting to keep the required capacity and to improve its technical efficiency in all areas from coal mining to the processing of coal even further. In this task, research and development have the same priority as ensuring present production. An important part of the research and development projects will be carried out in the context of a long term overall programme of the Mining Associations Research. This report gives details of the progress made in 1979, in mining technology and safety of pits and in the refinement of coal.

60822 **(NP—2904065) Black coal 1980/81.** (Gesamtverband des Deutschen Steinkohlenbergbaus, Essen (Germany, F.R.)). [nd]. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01.

Pictures illustrate the major developments on the energy sector, especially in coal mining, and the characteristic figures and data.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 60749, 60799, 60842, 61624

60823 **(ANL/EES-TM—183) Alternatives to deep-draft port dredging for US coal export development: a preliminary assessment.** Bertram, K.M. (Argonne National Lab., IL (USA)). Mar 1982. Contract W-31-109-ENG-38. 47p. NTIS, PC A03/MF A01. Order Number DE82021186.

This report compares deep-draft port dredging with alternative methods for increasing US coal export capacity. Five basic types of alternatives to port dredging are discussed: (1) coarse-coal pipelines, (2) coal slurry pipelines, (3) vessel-to-ship loading, (4) barge-carrying ships, and (5) extra-wide-beam coal ships. Because more than one approach is investigated for these alternatives, a total of 12 options are discussed. After describing the factors exerting growing pressure on the United States to improve its seaport coal-exporting capabilities, the current status of port dredging is presented. Funding, approval process, implementation time, and physical capability considerations are analyzed; significant uncertainties are found to exist about the financial and time requirements for port dredging. The 12 alternatives to port dredging are next described and compared on the basis of (1) financial considerations, (2) implementation-time requirements, and (3) environmental and technological constraints. At least two-thirds of the approximately 180 million tons of planned expansion by the year 2000 of coal-export capacity is based on the assumption of port dredging taking place. Therefore, it appears that port dredging alone could enable US ports to handle the coal export volumes projected for the year 2000. Dredging is also concluded to improve port efficiency and reduce general transportation costs the most. However, the uncertainties about the financing, the environmental concerns, and the time requirements for deep-draft dredging throw considerable doubt upon its viability as a single means of needed port capacity expansion. It is concluded that all of the alternatives except the barge-carrying-vessel systems would be good supplementary systems.

60824 **(DOE/ET/12512—2) Effect of coal cleaning on the quantity of sulfur dioxide and ash produced by coal-fired power generation in the northeastern United States.** Jones, R.M.; Jones, M.V. (Hoffman-Holt, Inc., Silver Spring, MD (USA)). 15 May 1982. Contract AC01-75ET12512. 141p. NTIS, PC A07/MF A01. Order Number DE82016060.

This study estimates the extent to which coal cleaning could reduce sulfur dioxide and ash output by Northeastern utilities. Total permissible SO_2 release was calculated for each state and the entire region based upon applicable environmental regulations. These results were compared with SO_2 outputs corresponding to the compositions of the coals reported by the utilities to the FERC and the compositions of cleaned coals derived from laboratory data. The cleaned coal compositions were based on data representative of counties supplying coal and assumed that the sulfur and ash content of the coals supplied to the utilities could be reduced to successively lower amounts under progressively advanced coal cleaning processes. SO_2 and ash outputs were estimated for eight assumed cleaning conditions, progressing from state-of-the-art physical cleaning methods to advanced chemical technologies. Coal data used in arriving at the state and regional output estimates were adjusted to account for relative tonnages delivered by the counties of origin and consumed by individual utilities during 1980. The results indicated that the assumed fine coal physical cleaning methods could reduce total SO_2 output by as much as 42% (as compared to reported coal compositions) and that advanced chemical cleaning technologies could achieve potential reductions of approximately 90%. Corresponding reductions were determined for ash wastes: the reported coals could be expected to produce about 14 million tons of ash; physically cleaned coals about 4 million tons; and advanced chemically cleaned coals approximately 1.3 million tons. Although no attempt was made in this study to assess economic aspects of coal cleaning, a brief discussion of cost-benefit analyses which others have made is included in the summary section of this report.

60825 **(DOE/PC/30235—T2) Selective grinding of coal for efficient pyrite removal. Project final report, December 31, 1981.** Hall, M.R. (Southern Illinois Univ., Carbondale (USA). Dept. of Engineering Mechanics and Materials). 1981. Contract FG22-80PC30235. 63p. NTIS, PC A04/MF A01. Order Number DE82018227.

Portions of document are illegible.

A detailed microscopic study of the distribution of pyrites in twenty low-, medium- to high-volatile bituminous and sub-bituminous coals was performed in conjunction with a number of grinding-beneficiation tests for pyrite removal. The distribution by volume for pyrite deposits smaller than fifty microns is usually trimodal with log-normal subdistributions peaked near 3, 7, and 17 microns. The observations indicate that surfaces produced by fracturing the coal, which tend to follow endogenous fissures and maceral boundaries, liberate the larger forms of pyrite very effectively but are progressively less effective as pyrite size decreases. The smaller pyrite particles are widely distributed and frequently encapsulated within compact macerals. The encapsulated fraction accounts for about twenty to forty volume percent of the pyrite which cannot readily be separated from the organic coal matrix. Some coal-swelling fluids seem to weaken selectively microfissures that connect to regions where pyrite deposits are located. This leads to significant improvements in the removal of inorganic sulfur and ash-forming minerals with less size reduction of the coal. Mechanical grinding of coal to sizes below +200 mesh is of little benefit for pyrite removal. There is a practical limit to the amount of the inorganic sulfur that can be removed by these processes. This limit is about seventy-five percent of the total inorganic sulfur. Further improvements could be achieved only by using processes such as magnetic or dielectric separation which do not require separation of the smallest pyrites from the small particles of coal in which they are contained.

60826 **(PB—82-208299) Transportation of coal, grain, and passengers by rail and waterways. Transportation research record.** Miller, J.J. (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). 1981. 52p. NTIS, PC A04/MF A01.

Contents of this paper are: Railroad rate deregulation--effects on corn and soybean shipments; Fuel efficiency in freight transportation; Transportation of coal to seaports via Mid-America inland waterway system; Impacts of proposed transshipment facility on price of delivered coal in New York; Physical and operating characteristics of ferry vessels; Role of waterborne transportation in urban transit; and Waterborne access to Gateway National Recreation Area and other waterfront recreation areas by passenger barge-tugboat combinations.

60827 **Size-dependent phenomena.** *Reviews of Modern Physics;* **53**: No. 4, S125-S134(Oct 1981).

Recommendations: (1) research is needed to improve understanding of the physical structure of coal and to relate measurable/describable properties to the mechanics of size reduction processes; (2) it is desirable to investigate the nature of the bond (adhesion) between organic and mineral matter, as well as between macerals, and to relate the strength of these bonds to size reduction processes; (3) invent energy-efficient grinding processes. Especially develop models to explain the decrease in grinding rate for particles below 50μ diameter; (4) attempt a rational description and classification of the mechanical properties of coal; (5) determine shear and other moduli and their dependence on coal rank, maceral and coal primary (chemical) structure; and develop new techniques (e.g., sound velocity measurements) for the determination of such moduli; (6) examine the statistical theory of coal network elasticity and investigate the statistics coal macromolecules may obey because they may be neither long enough nor flexible enough for the Gaussian statistics of polymer theory to be appropriate; (7) investigate the mechanisms of fracture initiation and propagation in coal and in

coal particles of various size; and (8) diffusion of the chemical comminuting agents in coals, swelling, the nature of the surface interaction between the coal and the comminuting agent, and the resulting crack initiation and/or propagation, all need to be investigated theoretically and experimentally.

60828 **Coal stockpile: how much is enough. How much is too much.** Mills, M.T. (Holston Defense Corp., Kingsport, TN). *American Institute of Industrial Engineers, Detroit Chapter, Proceedings of the Annual Conference;* 362-373(1981). (CONF-810538—). Detroit, MI, USA (17 May 1981).

Companies that stockpile coal often maintain a 60 to 90 days' supply during periods of relatively stable supply and 100 to 120 days' supply during periods of anticipated strikes by miners/railroad workers. This paper describes a procedure that can be used to (1) estimate the probabilities and durations of strikes, (2) calculate the cost of stockpiled coal, (3) calculate the cost of incurring the effects of a coal shortage, and (4) determine which will provide adequate supplies of coal more economically: a stockpile or contingency plans. The Delphi Method is used periodically to poll experts on the company's coal vendors and coal carriers and derive either consensus figures or a pessimistic-optimistic range of figures which translate into probability distributions of strike durations and cost of contingency plans. After the probability distributions have been prepared, the service level percentile to be achieved by the stockpile is used to predict the strike duration associated with that percentile and the cost of contingency plans associated with that percentile. It is then possible to calculate whether it would be cheaper to (1) stockpile enough coal to provide for the company's needs at the desired service level (2) implement the contingency plans when (and if) the need arises. The paper provides an easy-to-follow example and examines practical considerations of the Delphi questionnaire, probability distributions, and stockpile adjustments.

60829 **Study of transhipment as part of retail coal delivery.** Ward, R.E. (West Virginia Univ., Morgantown, WV); Gochenour, D.L. Jr. (West Virginia Univ., Morgantown, WV); Kuo, D.D. *American Institute of Industrial Engineers, Detroit Chapter, Proceedings of the Annual Conference;* 545-548(1981). (CONF-810538—). Detroit, MI, USA (17 May 1981).

A report is made of the application of the classic transportation model to the problem of evaluating alternate geographical locations for retail coal yards within West Virginia. The coal yards would serve as transhipment points between the mine mouth and the eventual consumer, in this case West Virginia public buildings. Briefly discussed is the establishment of market zones and the formulation of the transhipment point model. Discussed in greater depth is the data assembly, including forecasts of zonal monthly coal demand and the development of the transportation network, incorporating rail, barge, and truck. Also presented are the results of four case studies. The cases differ based on the assumed mode or combination of modes used to deliver coal to the transhipment points. Truck is always the assumed mode for delivery to the public buildings. The results presented include the recommended location of transhipment points, their estimated peak monthly inventory in terms of tons of coal storage area required, and comparison of transportation costs between the four case studies. The conclusions cite assumptions made and the limitation of both the methodology and the suggested use of coal yard transhipment points.

0140 Combustion

REFER ALSO TO CITATION(S) 60746, 60751, 60762, 60764, 60765, 60774, 60775, 60776, 60777, 60778, 60779, 60780, 60789, 60790, 60791, 60792, 60795, 60801, 60843

60830 **(ANL/ECT—12) Fluidized-bed combustion: a review of environmental aspects.** Hubble, B.R. (Argonne National Lab., IL (USA)). Jan 1982. Contract W-31-109-ENG-38. 92p. NTIS, PC A05/MF A01. Order Number DE82021238.

This report highlights potential environmental problems associated with fluidized-bed combustion (FBC) and identifies areas where additional research and development effort is required. Environmental data from commercial-scale (e.g., industrial demonstration) units are needed before an adequate environmental assessment of FBC can be made. Currently available data come from small-scale test units and vary in both quantity and quality for the potential environmental pollutants considered. Of the regulated pollutants, only for sulfur dioxide (SO_2) does there exist a fairly good data base; this data base suggests that the major issue in SO_2 control may be one of economics. For both nitrogen oxides (NO/sub x/) and particulate matter, it remains to be seen if commercial-size units can meet regulatory standards over extended operating periods or not. With respect to solid-waste disposal, the available data indicate that (1) solid wastes generated by FBC will not likely be deemed hazardous; (2) FBC wastes should meet current standards for sanitary landfills, including the requirement that ground water at the disposal boundary meet the National Interim Primary Drinking Water Regulations; and (3) problems with respect to pH, total dissolved solids, and sulfate could exist if the National Secondary Drinking Water Regulations are included in sanitary-landfill regulations, as has been suggested. A very limited data base exists for trace metals, organic compounds, toxic emissions, radioisotopes, steam-cycle emissions, and workplace exposure in connection with FBC operations. For some of these same pollutant types and conditions, no good data base exists for pulverized-coal combustion (PCC), either; this deficiency suggests a need for comparative studies of FBC and PCC.

60831 (DOE/METC—82-47, pp 34-39) **Status and overview of pressurized fluidized-bed combustion.** Crouse, F.W.; McClung, J.D.; Carpenter, L.K. (Morgantown Energy Technology Center, WV). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The goal of the Department of Energy (DOE) PFBC Program is to develop an understanding of the fundamental scientific and engineering mechanisms in order to predict performance and define the economic and environmental characteristics of the technology. Emphasis in FY 82 is shifting from major demonstration projects to smaller, R and D-oriented proof-of-concept projects whereby the technology is developed to a point where sufficient data are available for the private sector to conduct their own risk assessments. In addition, emphasis will shift to assessing advanced approaches in the technology which will provide step increases in performance as well as reduced environmental emissions. The Morgantown Energy Technology Center (METC) is the lead center for PFBC Program implementation. METC activities will be geared towards developing a data base for this technology by sponsoring high-risk R and D through the proof-of-concept stage utilizing small fundamental research facilities. This data base will then be expeditiously passed to industry and utilities. The paper presents an overview of the current METC pressurized fluidized-bed program and its future direction.

60832 (DOE/METC—82-47, pp 60-74) **Hot gas cleanup requirements for PFBC 1982 perspective.** Rubow, L.; Zaharchuk, R. (Gilbert Associates, Inc., Reading, PA). 1982. NTIS, PC A25/MF A01.

From 2. annual contractors meeting on gas stream clean up; Morgantown, WV, USA (17 Feb 1982).

The focal point of Pressurized Fluidized Bed Combustion (PFBC) development is hot gas cleanup to meet turbine requirements and EPA standards. A historical perspective of PFBC research and development work in alkali metal induced corrosion, alkali metal thermochemistry modeling, recent test data, and suggested limits is presented. Although short term testing indicates that corrosion may not be a problem, long term testing development/standardization of measurement techniques, alkali cleanup development, continued modeling, and large scale tests are all required. The evolution of particulate cleanup technology and turbine tolerance limits are discussed. The impact of particle loading and size distribution on turbine life and the effect of turbine life on cost of electricity are discussed. Erosion modeling as a means of correlating test results with turbine characteristics is recommended. Benefits of hot gas cleanup are discussed including potential capital cost benefits, pressure loss reductions, and improved turbine life, all resulting in lower cost of electricity. Deposition is discussed briefly and it is recommended that on-line cleaning devices be considered.

It is concluded that meeting NSPS will probably result in a cost benefit, and that advanced hot gas cleanup will improve plant performance and also acceptance of PFBC due to anticipated longer turbine lives. The overall conclusion is drawn that large scale, long term turbine tests are required before PFBC can be commercialized.

60833 **(DOE/NASA/10350—34) Catalytic combustion of actual low- and medium-heating-value gases.** Bulzan, D.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1982. Contract AI01-77ET10350. 17p. (NASA-TM—82930; CONF-821018—2). NTIS, PC A02/MF A01. Order Number DE82020329.

From American Society of Mechanical Engineers conference on power generation; Denver, CO, USA (17 Oct 1982).

Catalytic combustion of both low- and medium-heating-value gases was demonstrated using actual coal-derived gases obtained from operating gasifiers. A fixed-bed gasifier with a complete product gas cleanup system was operated in an air-blown mode to produce low, 3.7 MJ/m^3 (99 Btu/scf), heating-value gas. A fluidized-bed gasifier with a water quench product gas cleanup system was operated in both an air-enriched and an oxygen-blown mode to produce low, 6 MJ/m^3 (160 Btu/scf), and medium, 9.7 MJ/m^3 (250 Btu/scf), heating-value gas, respectively. Noble metal catalytic reactors were evaluated in 12 cm flow diameter test rigs on both low- and medium-heating-value gases. Test conditions included inlet temperatures from 500 to 700 K, pressures of 5 x 10^5 to 15 x 10^5 Pa, reference velocities from 10 to 30 m/s, and adiabatic reaction temperatures from 1100 to 1450 K. Combustion efficiencies greater than 99.5 percent were obtained with all coal-derived gaseous fuels. NO/sub x/ emissions ranged from 0.2 to 4 g NO_2/kg fuel and were attributed to the conversion of fuel-bound nitrogen contained in the fuel. Conversion of fuel-bound nitrogen to NO/sub x/ ranged from about 40 to 100 percent.

60834 **(DOE/PC/30305—T5) Formation of submicron particulates by coal combustion. Final report, October 1980-December 1981.** Sherman, P.M.; Glass, D.R.; Postman, D.; Washabaugh, P. (Michigan Univ., Ann Arbor (USA). Dept. of Aerospace Engineering). May 1982. Contract FG22-80PC30305. 69p. NTIS, PC A04/MF A01. Order Number DE82019770.

A laboratory arrangement was designed and built to burn coal dust under controlled conditions in order to investigate the formation of submicron particles. Measurements made using a transmission electron microscope showed results consistent with the evaporation/condensation analytical computer model developed. The trends observed are not considered conclusive and should be investigated further. They suggest that there is a bimodal distribution in particle size and that the smallest particle fraction (< 300 A) will be inhibited from forming by (1) a decrease in excess oxygen or combustion close to stoichiometric conditions; (2) elimination of strong temperature gradients or fast cooling rates; (3) an increase in surface area of entrained particles.

60835 **(EPRI-AP—2517) Design strategy for the combustion of coal-derived liquid fuels.** Beer, J.M.; Jacques, M.T.; Farmayan, W.F.; Teare, J.D. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Aug 1982. 175p. NTIS, PC A08/MF A01. Order Number DE82905496.

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Results are reported of experiments on the amenability of SRC-II coal-derived liquid fuels to combustion process modification by air staging for NO/sub x/ and particulates emission control. Two experimental systems were used: (1) a laboratory laminar flow reactor for determining rates of evolution of fuel-bound nitrogen from pyrolyzing arrays of 150 μm SRC-II fuel droplets; and (2) a pilot plant scale furnace for determining the effects of combustion air staging, air preheat, quality of atomization and fuel type in the conversion of fuel-nitrogen to NO/sub x/. These latter experiments were guided by computations of the conversion of fuel-nitrogen as a function of fuel equivalence ratio, temperature and residence time in the fuel rich stage of the flame. Results of the combustion experiments show that there is a significant potential for controlling NO/sub x/ and particulates emissions in coal-derived liquid fuel flames by combustion modifications; NO/sub x/ emission levels were reduced from 550 ppM (at 3% O_2) measured in fast mixing single stage flames to less than 100 ppM (at 3% O_2) under optimized staged combustion conditions with particulates emission levels below 0.33 x 10^{-2} lb^{0}10^6 Btu. The overall excess air was maintained at ~ 10% in the experiments.

60836 **(NYSERDA—81-25) Commercial-sector coal/oil-slurry demonstration program. Final report.** Dooher, J.P. (Adelphi Research Center, Inc., Garden City, NY (USA)). Jul 1981. 59p. NTIS, PC A04/MF A01. Order Number DE82905983.

This report represents work accomplished on the combustion properties of coal-No. 4 oil-water (COW) emulsions to which alkali absorbents for sulfur dioxide removal have been added. The fuels tested contained the following ratios of coal-oil-water; 44-44-12 and 42-42-16. The stoichiometric percentage of additives, based on the total sulfur in the fuel, used in the combustion tests was 100%. Using the sulfur dioxide absorbents, up to 86% of the SO_2 in the stack gas was removed. The thermal efficiencies of the emulsions were approximately the same as with oil, 89%. Ash deposition was not found to be a problem when burning COW emulsions without alkaline additives. Deposit formation was greatly increased with the addition of alkali additives. The feasibility of using a baghouse for particulate removal was also studied. The efficiency of the baghouse using a 44-44-12 emulsion with and without soda ash was determined. Collection efficiency was 99.8% and 99.3% respectively. The fly ash was easily cleaned from the baghouse filters.

60837 **(SAND—82-8817) Development and application of advanced diagnostics methods in fossil-fuel combustion studies.** Hardesty, D.R. (Sandia National Labs., Livermore, CA (USA)). Jul 1982. Contract AC04-76DP00789. 19p. (CONF-820510—5). NTIS, PC A02/MF A01. Order Number DE82021705.

From Spring meeting for the Society for the Advancement of Materials and Process Engineering; San Diego, CA, USA (4 May 1982).

In support of a national effort to effect an increase in coal utilization, Sandia National Laboratories Livermore is conducting research on the combustion of fossil fuels. This activity is integrated with the fundamental combustion and diagnostics research in the Sandia Combustion Research Facility (CRF). It mirrors the dual theme of the CRF program, with an emphasis both on improved understanding of pulverized fuel combustion and conversion processes, as well as the development of new diagnostic techniques to assist in that improvement. This paper describes the various elements of the Sandia Fossil Fuel Combustion Program. Highlights of recent experimental results are summarized in the two major areas of interest - combustion research and combustion diagnostics related to coal-fired power systems. A growing involvement with materials scientists at Sandia is noted as we crystallize the coal sciences element of our pulverized coal combustion studies.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 60812, 60828, 60829, 61624

60838 (CONF-8110215—, pp 123-127) **Future of the Illinois coal industry.** Pensoneau, T. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

Technology assessment is reviewed for the coal industry's efforts to solve environmental and safety concerns for combustion uses. The economic stakes are reviewd. (PSB)

60839 (CONF-8110215—, pp 138-140) **Illinois Office of Coal Commerce.** Castle, J.W. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

The marketing efforts of Illinois are reviewed. (PSB)

60840 (CONF-8110215—, pp 162-167) **Progress report on federal energy policy.** Cook, J.O. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This paper assesses the progress of the federal energy policy, the direction it's taking and the effects projected for Illinois, especially for the coal industry. (PSB)

60841 **(DOE/RA/02625—T1) Markets for low- and medium-Btu coal gasification: an analysis of 13 site specific studies.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Sep 1981. Contract AC01-78RA02625. 44p. NTIS, PC A03/MF A01. Order Number DE82007994.

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In 1978 the US Department of Energy (DOE), through its Office of Resource Applications, developed a commercialization plan for low- and medium-Btu coal gasification. Several initial steps have been taken in that process, including a comprehensive study of industrial markets, issuance of a Notice of Program Interest, and funding of proposals under the Alternate Fuels Legislation (P.L. 96-126). To assist it in the further development and administration of the commercialization plan, the Office of Resource Applications has asked Booz, Allen & Hamilton to assess the market prospects for low- and medium-Btu coal gasification. This report covers the detailed findings of the study. Following the introduction which discusses the purpose of the study, approach used for the assignment and current market attitudes on coal gasification, there are three chapters on: systems configurations and applications; economic and finanical attractiveness; and summary of management decisions based on feasibility study results. The final chapter briefly assesses the management decisions. The general consensus seems to be that coal gasification is a technology that will be attractive in the future but is marginal now. 6 figures, 5 tables.

0160 Health And Safety

REFER ALSO TO CITATION(S) 60814, 60815, 61017, 62164, 62165

60842 **(PB—82-189705) Health hazard evaluation report No. HHE-80-104-101, MSHA mine I.D. No. 11-02632, Freeman Coal Company, Farmersville, Illinois.** Greife, A.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Dec 1980. 10p. (HHE—80-104-101). NTIS, PC A02/MF A01.

Worker exposures to asbestos (1332214) were surveyed at Freeman Coal Company, Crown III mine, Coal Prepartion facility (SIC-5052) in Farmersville, Illinois on February 19, 1980. The evaluation was requested by an authorized representative of the United Mine Workers of America on behalf of the construction company under contract to build the coal preparation facility. Personal breathing zone samples were collected from seven employees involved in installing flat Transite as a firewall. General area samples were collected at various areas in the worksite, and bulk samples of dust and the Transite board also were collected. All personal breathing zone samples were below the Mine Safety and Health Administration Standard of 2.0 fibers per cubic centimeter, but 20 percent of the samples exceeded the NIOSH standard of 0.1 fiber per cubic centimeter. Breathing zone and bulk samples contained chrysotile (12001295) asbestos. Workers used respirators and safety glasses and shoes, but disposable clothing was not used, and general personal hygiene was not strictly practiced at lunch time or during smoking breaks. The authors conclude that an asbestos dust hazard may exist at the facility. They recommend that all exposures to the asbestos board be controlled, proper protective clothing be worn, and medical surveillance be instituted.

60843 **(PB—82-193566) Coal dust and silica survey, Crisp County Power Commission, coal-fired power plant, Cordele, Georgia. Final report.** Roper, C.P. Jr. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Nov 1978. 14p. NTIS, PC A02/MF A01.

Environmental and personal air samples were analyzed for the presence of hazardous concentrations of coal and silica (7631869) dusts at the coal fired power facility of the Crisp County Power Commission (SIC-4911) in Cordele, Georgia, on July 12, 1978. The evaluation was requested by the management on behalf of an unspecified number of workers. Noise measurements also were taken. Airborne dust concentrations ranged from nondetectable to 0.15 milligrams per cubic meter (mg/cu m), well below the OSHA standards of 2.4 mg/cu m for coal dust and 10 mg/cu m for respirable dust containing quartz. Exposures to free crystalline silica were below the detectable limits of the sampling and analytical method. Noise readings ranged from 67 to 116 decibels (dB) at different locations. The OSHA standard for noise exposure is 90dB for an 8 hour daily exposure. The investigators concluded that coal and silica dust concentrations were not hazardous to workers at the time of the investigation, but that some workers were exposed to excessive noise. Recommendations were to wet the coal before it is loaded or moved, and to develop and enforce a hearing conservation program. Procedures for work in confined spaces also are recommended.

60844 **Generation and delivery of coal liquid aerosols for inhalation studies.** Springer, D.L.; Clark, M.L.; Willard, D.H.; Mahlum, D.D. (Pacific Northwest Lab., Richland, WA). *American Industrial Hygiene Association Journal;* **43**: No. 7, 486-489(Jul 1982).

To aid in the toxicologic evaluation of solvent refined coal (SRC) materials, we developed an aerosol generation system for whole-body inhalation exposure of experimental animals to coal liquids. The main components of the exposure system were an aerosol generator, a manifold for delivery of the aerosol, three exposure chambers and an exhaust system. High-boiling coal liquids from the SRC-I and the SRC-II processes were as test materials. Aerosol concentrations were measured by drawing aerosol samples from the chambers through a Metricel filter and eluting the coal liquid into chloroform.Since these coal liquids have an ultraviolet absorption peak at 254 mm, the absorbance was determined at this wavelength. As part of the experiment, we evaluated the Solo-Sphere, Rec and Collison neubulizer as aerosol generators for the coal liquids. Both the Solo-Sphere and Retec provided adequate concentrations of respirable particles; however, aerosol concentrations within the exposure chamber provided adequate concentrations of respirable particles; however, aerosol concentrations within the exposure chamber were more consistent with the Solo-Sphere. Low mass output and plugging were encountered with the Collison. Use of the Solo-Sphere generator and manifold delivery system resulted in consistent and uniform aerosol concentrations and particle sizes in the exposure chamber over a 15-day test period. Analysis of the chamber atmosphere when SRC-I process solvent was used indicated the presence of vapors as well as particles. The ultraviolet absorption spectrum suggested that two-ring polynuclear aromatic compounds were the major constituents of the vapor phase.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 60813, 61608, 61641, 61656

60845 **(GAO/PLRD—81-49) DOE contracts to demonstrate coal liquefaction adequately protect government interests.** (General Accounting Office, Washington, DC (USA). Procurement, Logistics, and Readiness Div.). 17 Aug 1981. 23p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

Report to the Chairman, Subcommittee on Interior and Related Agencies, Committee on Appropriations, House of Representatives.

Solvent Refined Coal I and Solvent Refined Coal II are processes for converting high ash and sulfur content coals to clean burning, environmentally acceptable solid and liquid fuels. The Department of Energy in 1980 awarded contracts to two companies to demonstrate these processes. The Chairman asked GAO to evaluate the negotiation and award of these contracts to determine whether they adequately consider and protect the Government's interest. GAO found that the contracts adequately protect the Government's interest and were awarded in accordance with estab-

lished Federal and Department of Energy procurement policies and regulations.

60846 **(NP—2904016) Mitigating the impacts of coal/energy development in the western states. Final report, of the western coal planning assistance project.** (Missouri River Basin Commission, Omaha, NE (USA)). Mar 1981. 58p. NTIS, PC A04/MF A01. Order Number DE82904016.

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The Western Coal Planning Assistance Project's major goal was to help planners better understand the nature and impacts of coal development. All indicators point to success in this effort. User's evaluations of the Western Coal Planning Reference System show that there was a need for such a guide to coal-related facts and impact methodologies and that the system is being used. Participants evaluations of the training workshops provided further evidence of the project's positive impact. In summary, the following conclusions can be drawn: 1. Planners will continue to use the reference system, particularly if it is kept current. There will always be a demand for its basic, introductory information and references, since new planners are constantly coming into the area and more communities are being affected by energy development. 2. The success of the project was due not only to the quality of its products, but also to the intensive campaign that was waged to acquaint potential users with the reference system and stimulate their interest in further training. 3. Funds should be sought to continue updating and adding to the reference system and to continue to provide training opportunities for planners. More specific conclusions and recommendations are given.

60847 **(NP—2904017) Western coal planning assistance project: Phase I. Final report.** (Missouri River Basin Commission, Omaha, NE (USA)). Feb 1979. 70p. NTIS, PC A04/MF A01. Order Number DE82904017.

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Phase I of the Western Coal Planning Assistance Project (WCPAP) was initiated by the Missouri River Basin Commission (MRBC) and the United States Geological Survey's Resource and Land Investigations (RALI) Program in September 1977. The project encompasses the major coal areas of Montana, North Dakota, and Wyoming. Three objectives of phase I were: (1) to meet with State and local planners and decisionmakers to determine their technical and informational needs for assessing coal development alternatives; (2) to develop the analytical tools and methods needed to respond to legislative, societal, economic, and physical constraints; and (3) to conduct planning assistance workshops involving State, regional, and local planners and decisionmakers. The purpose of this Final Report is to describe how these objectives were addressed and to present conclusions and recommendations resulting from this effort.

02 PETROLEUM

REFER ALSO TO CITATION(S) 61672

0201 Reserves

REFER ALSO TO CITATION(S) 61668, 62189

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 61642, 62050, 62192

0203 Drilling And Production

60848 **(DOE/ET/08002—26) Penn Grade Micellar Displacement Project. Final report.** Ondrusek, P.S.; Paynter, W.T. (Pennzoil Co., Bradford, PA (USA)). Aug 1982. Contract AC21-75ET08002. 249p. NTIS, PC A11/MF A01. Order Number DE82021944.

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Results of the five year study are presented in this report. The Penn Grade Micellar Displacement Project was a test of a Microemulsion Flooding process on typical post-waterflood Bradford Third Sand Reservoir. The project was located on Pennzoil's Lawry Lease in the heart of the Bradford Field in Northern Pennsylvania. The tertiary oil recovery system was Marathon Oil Company's Maraflood Process which utilized a custom designed micellar slug system and biopolymer mobility buffer. The project was conducted in two parts. Phase I consisted of the drilling, coring, and utilization of well No. HO-68 to determine the injectivity characteristics of Maraflood process fluids. Phase I occurred from July 1975 through July 1976 and the favorable results led to a decision to proceed with Phase II, the 24-acre project. Phase II, the development, operation, and evaluation of a 24-acre Maraflood test occurred from March 1976 through December 1980. Since mobility control was not maintained during the project and could not be achieved by increased viscosity because of already inadequate injection rates, a decision was made to terminate project operations on November 20, 1980. The cumulative oil recovery was only 5.19% of the estimated pre-project oil in place so the project has to be considered a failure. Appendix A discusses the oil recovery efficiency in more detail.

60849 **(DOE/ET/12056—21) Design considerations for a steam-injection pilot with in-situ foaming.** Siddiqui, M.H.; Sanyal, S.K.; Horn, A.J. (Stanford Univ., CA (USA). Petroleum Research Inst.). Aug 1982. Contract AC03-76ET12056. 134p. NTIS, PC A07/MF A01. Order Number DE82021605.

Portions of document are illegible.

This report reviews the necessary aspects of the planning, operation, evaluation, environmental impact and cost to implement a field pilot of steam injection with in-situ foaming. The Stanford University Petroleum Research Institute (SUPRI) is planning to implement such a pilot in Kern County, California. The cost of the pilot will be shared by the US Department of Energy and an oil company. Some important aspects of drilling and completion programs and their specifications, permits from regulatory bodies, and downhole tools to improve steam stimulation are discussed. The essential surface facilities which include water treatment plant, steam generator, demulsifier and dehydrator are considered. The necessary laboratory research in support of the pilot has been recommended. The formation evaluation and reservoir engineering effort for the pilot has been divided into three phases: reservoir definition, reservoir monitoring and post-pilot study. Appropriate techniques applicable to each phase of the test have been discussed. The environmental impact regulations as related to the steam injection process have been considered. In particular, the environmental problems associated with the burning of crude oil and desulfurization of flue gas have been discussed. Other environmental considerations such as solid and liquid waste disposal, health and safety are also discussed. An estimate of the cost of this field test is presented. Three scenarii (for pilots with high, medium, and low investment potentials, respectively) are presented. Since this report was prepared, a specific site for the supri pilot has been chosen. Appendices G and H present the details on this site.

60850 **(SAND—82-7041) Stability of steam plus nitrogen displacements of water in a porous medium. Annual report, February 1981-January 1982.** Krueger, D.A. (Colorado State Univ., Fort Collins (USA). Dept. of Physics). Jun 1982. Contract AC04-76DP00789. 62p. NTIS, PC A04/MF A01. Order Number DE82016379.

Laboratory experiments injecting steam or a steam-nitrogen mixture into a transparent, bead-packed cell (39 cm x 19 cm x .64 cm) have been performed. We have observed (a) steam-stable, (b) steam-stable, nitrogen-stable, (c) steam-stable, nitrogen-unstable, (d) steam-unstable, nitrogen-unstable, and (e) steam-unstable displacements of water. Three techniques are used simultaneously: (1) visual observation of the gas/liquid fronts, (2) temperature measurements within the bead pack to observe the rise ahead of the front, and (3) infrared movies to follow the temperature changes (as small as 1°C) on the cell surface. The cells are operated near atmospheric pressure. results of Stegemeier, Laumbach, and Volek could be used to scale to actual reservoir conditions. The cells are operated to insure a constant average velocity of the condensation front which allows for a more straightforward comparison of theory and experiment. Despite the relatively small size of our cell,

our study shows that the fluid flow and heat flow at the front are the same as that for a front moving in an infinite media. Thus, we are studying the basic properties of the front. Our experiments have shown that mobility arguments are inadequate to predict the stability of condensing flow, and the more general theories of Miller and Krueger are required. For steam displacing nitrogen, we have observed the two gas zones separated by a water zone. That is, the two gases do not just mix together to form a single gas phase. An understanding of out stability experiments, the gravity override experiments, and this liquid zone for steam displacing nitrogen will have important applications in optimizing enhanced oil recovery projects utilizing steam and nitrogen.

0204 Processing

REFER ALSO TO CITATION(S) 60717

60851 **(CSIR-CENG—365) Cracking activity of Zeolite y catalysts synthesized from a South African.** Howden, M.G. (Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Research Group). Apr 1981. 28p. NTIS, PC A03/MF A01.

Rare earth cation exchanged zeolite Y catalysts, rare earth acidic exchanged zeolite Y catalysts, and ultrastable zeolite Y catalysts with or without exchanged rare earth cations were prepared from ceramic microspheres which contained 24% NaY zeolites. A preliminary evaluation of the gas oil cracking activities of these catalysts and four commercial catalysts was made using a fixed bed reactor. Two of the prepared catalysts were tested also in a microactivity reactor. The synthezied catalysts showed no major differences in conversion performance compared with the commercial products.

60852 **(DOE/RG/06435—T1) Simulator user's manual for petroleum refining and transportation cost estimation.** (Bonner and Moore Associates, Inc., Houston, TX (USA)). 15 Jun 1979. Contract AC01-78RG06435. 138p. NTIS, PC A07/MF A01. Order Number DE82021790.

This manual describes the use and control of a Simulator which represents petroleum refining process operations and the transport of raw materials to and finished products from a specified refinery. The Simulator is an interactive system which allows its user to develop operation and capital cost estimates for any specified fuel products refining situation. Because the Simulator is designed to be interactive with the user, this manual is primarily a reference document. It describes the process yields, operating requirement factors, and investment cost factors employed in the Simulator, as well as the methodologies of estimating transportation costs. In general, this manual assumes a certain level of knowledge of petroleum refining technology and economics. In addition to an assumed background of refining familiarity, this manual assumes that the user understands computer applications in general and, in particular, has knowledge of time-sharing and terminal operations on the IBM/370 available to DOE. Following the introduction, Section 2 covers user procedures - what the user can do. Section 3 explains the data content and simulation controls - the how and why of the system. Section 4 documents the Simulator itself. An appendix of the base-case definitions supports this manual.

60853 **(DOE/RG/06435—T2) Simulator system manual.** (Bonner and Moore Associates, Inc., Houston, TX (USA)). 31 Jul 1979. Contract AC01-78RG06435. 73p. NTIS, PC A04/MF A01. Order Number DE82021609.

Portions of document are illegible.

This systems manual documents the Simulator which represents petroleum refining process operations and the transport of raw materials to and finished products from a specified refinery. Section 1 describes the two main Simulator programs. Section 2 of this document presents each system subroutine, organized alphabetically. Section 3 details each system function, also organized alphabetically.

60854 **(PB—82-208455) Industrial applications of agricultural raw materials (industriele toepassingen van landbouwgrondstoffen). Industrial report no. 11.** (Nationale Raad voor Landbouwkundig Onderzoek TNO, The Hague (Netherlands)). 1982. 65p. NTIS, PC A04/MF A01.

In view of the steadily increasing prices of fossil raw materials, a study was made of the technical possibilities for the use of agrarian products as raw material for the (petro) chemical industry. Chapter 1 gives a survey of the existing raw material situation for the (petro) chemical industry. In Chapter 2, the working group has presented a rough survey of the available agrarian raw materials. Chapter 3 gives a survey of possible processing methods of these raw materials to energy products and to chemicals which may serve as raw material for the chemical industry or, as end product, have special qualities or may compete with products of the (petro) chemical industry. The working group has not been able, within the limited time available and in its report, to indicate whether and under which conditions the processes mentioned will be economically feasible in the future. A subsequent study in which economists and representatives of the chemical industry participate would be necessary for this purpose. Chapter 4 discusses briefly factors which may restrict the use of agrarian raw materials in the chemical industry. In Chapter 5, the working group makes a few recommendations for research which must be performed to make possible the application of certain processes as well as for research to show whether certain processes are applicable. The working group has not studied the treatment of fine chemical products. This area is very comprehensive. Due to the high prices of fine chemical products, such processes may, however, become attractive in the future. A recommendation for the approach of this sector is made in Chapter 5.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 60849, 60852, 61660, 62050, 62051

60855 **(AD-A—112505/3) Persian Gulf and the national interest. Professional paper.** Wilson, D.P. (Center for Naval Analyses, Alexandria, VA (USA). Naval Studies Group). Feb 1982. 19p. (CNA-PP—339). NTIS, PC A02/MF A01.

With gasoline lines a fading memory, it is easy for Americans to misinterpret the energy crisis as overinflated, and even easier to underestimate the importance of the Persian Gulf. Yet, it was just two years ago that former President Carter designated the Persian Gulf as a region of vital national interest. His purpose, in what came to be known as the Carter Doctrine, was to help ensure the steady flow of petroleum to the world market. President Reagan has subsequently confirmed that policy by increasing the U.S. military presence in the Inidan Ocean, strengthening the Rapid Deployment Force (RDF), and selling AWACS and other advanced military equipment to Saudi Arabia. What seemed to be a sensible policy direction with the turmoil in Iran, skyrocketing oil prices, and the Soviet intervention in Afghanistan, has come under increasing criticism in the light of today's plentiful supplies of oil. A growing chorus of optimists argues that reliance on the unfettered market will give us a future of abundant energy and freedom from dependence on oil imports.

60856 **(DOE/RG/06299—T1) Policies to manage gasoline consumption during a shortage and their effect on retail gasoline queues.** (Resource Planning Associates, Inc., Cambridge, MA (USA)). 23 Feb 1979. Contract AC01-78RG06299. 39p. NTIS, PC A03/MF A01. Order Number DE82021820.

Portions of document are illegible.

Actions which might be taken by federal, state, and local governments as well as retailers to influence the conditions under which gasoline is sold at the retail level during fuel shortages are examined in this report. The objective is to identify the major factors which led to lines forming at service stations and determine how they could be restrained in the event of another real or perceived shortage. The single most effective means of reducing queues is the minimum purchase requirement. There is also a need to increase general confidence in government ability to control allo-

cation efficiently and equitably during a shortage. Recommendations are included. (DMC)

60857 (DOE/RG/06623—T1) Gasoline price data systems. (Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA)). May 1980. Contract AC01-78RG06623. 57p. NTIS, PC A04/MF A01. Order Number DE82021284.

Portions of document are illegible.

Timely observation on prices of gasoline at the wholesale and retail level by geographical area can serve several purposes: (1) to facilitate the monitoring of compliance with controls on distributor margins; (2) to indicate changes in the competitive structure of the distribution system; (3) to measure the incidence of changes in crude oil and refiner costs on retail prices by grade of gasoline, by type of retail outlet, and by geographic area; (4) to identify anomalies in the retail pricing structure that may create incentives for misfueling; and (5) to provide detailed time series data for use in evaluating conservation response to price changes. In order to provide the needed data for these purposes, the following detail on gasoline prices and characteristics of the sampling procedure appear to be appropriate: (1) monthly sample observations on wholesale and retail prices by gasoline grade and type of wholesale or retail dealer, together with volume weights; (2) sample size sufficient to provide detail by state and large cities; (3) responses to be tabulated and reports provided within 30 days after date of observation; and (4) a quick response sampling procedure that can provide weekly data, at least at the national level, when needed in time of rapidly changing prices. Price detail by state is suggested due to its significance for administrative purposes and since gasoline consumption data are estimated by state from other sources. Price detail for large cities are suggested in view of their relevancy as problem areas for vehicle emissions, reflecting one of the analytical uses of the data. In this report, current reporting systems and data on gasoline prices are reviewed and evaluated in terms of the needs outlined above. Recommendations are made for ways to fill the gaps in existing data systems to meet these needs.

60858 (EPRI-EA—2447-SY) World oil. Sweeney, J.L. (Stanford Univ., CA (USA). Energy Modeling Forum). Jun 1982. 129p. NTIS, PC A07/MF A01. Order Number DE82906440.

Results obtained through the application of 10 prominent world oil or world energy models to 12 scenarios are reported. These scenarios were designed to bound the range of likely future world oil market outcomes. Conclusions relate to oil market trends, impacts of policies on oil prices, security of oil supplies, impacts of policies on oil security problems, use of the oil import premium in policymaking, the transition to oil substitutes, and the state of the art of world oil modeling.

60859 (NP—2904425) 1981 California oil and gas production statistics and new-well operations: preliminary report. Publication No. PRO3. (California Dept. of Conservation, Sacramento (USA). Div. of Oil and Gas). Jan 1982. 18p. NTIS, PC A02/MF A01. Order Number DE82904425.

Data on oil, gas, and water production in California are presented under the headings: state totals; state and federal offshore production; new well operations; production from oil fields-1981; federal offshore production-1981; and gas, condensate, and water production from gas fields and zones-1981. Data are presented in tabular form with productivity of each field reported. State oil production (386,000,000 bbls) increased by 29,000,000 bbl over 1980; natural gas production (397,000,000 Mcf) increased by nearly 80,000,000 Mcf over 1980; water production (2,410,000,000 bbl) increased by approximately 275,000,000 bbl over 1980. (DMC)

0208 Waste Management

REFER ALSO TO CITATION(S) 60836, 62025

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 62047

60860 (CONF-8104171—Absts.) Proceedings: second annual Gulf of Mexico information transfer meeting. (Texas A and M Univ., College Station (USA). Dept. of Oceanography). Nov 1981. 113p. NTIS, PC A06/MF A01. Order Number DE82906198.

From 2. annual Gulf of Mexico information transfer meeting; New Orleans, LA, USA (30 Apr 1981).

Portions of document are illegible.

The proceedings contain abstracts of research programs on the environment of the Gulf of Mexico. Topics include topography, environmental effects of oil spills, economic effects of oil spills, geology, fisheries, marine ecology, endangered species studies, coastal and continental shelf ecosystems studies, and satellite oceanography. (ACR)

60861 (PB—82-187071) Final environmental impact statement: proposed 1981 Outer Continental Shelf oil and gas lease sale offshore central and northern California, OCS Sale No. 53. Volume 1. (Bureau of Land Management, Los Angeles, CA (USA). Pacific Outer Continental Shelf Office). Sep 1980. 789p. NTIS, PC A99/MF A01.

Final Environmental Impact Statement (FEIS), Sale No. 53, covered the Outer Continental Shelf (OCS) oil and gas lease sale area offshore central and northern California. Consultation and coordination with interested Federal agencies, State and local governments, institutions, groups, and individuals was undertaken in preparation of a Draft EIS concerning a proposed OCS lease sale. The Environmental Impact Statement considered all available data and evaluated potential effects of the proposed sale which might occur during exploration, development, and production of mineral resources.

60862 (PB—82-192295) Inventory and evaluation of California coastal recreation and aesthetic resources: Volume I. Executive summary (final). (Granville Corp., Washington, DC (USA)). May 1981. 26p. NTIS, PC A03/MF A01.

The objective of this study is to describe existing California coastal and offshore recreation and aesthetic resources and to determine the value of recreation activities to recreationists, the recreation industry, and local economies. Aesthetic resources include visual resources as well as other sensory experiences. The primary purpose of this study is to inventory coastal California recreation and aesthetic resources that may be affected by proposed Outer Continental Shelf oil and gas development activities and to evaluate their significance.

60863 (PB—82-192303) Inventory and evaluation of California coastal recreation and aesthetic resources. Volume II: synthesis of findings. Final report. (Granville Corp., Washington, DC (USA)). May 1981. 677p. NTIS, PC A99/MF A01.

The objective of this study is to describe existing California coastal and offshore recreation and aesthetic resources and to determine the value of recreation activities to recreationists, the recreation industry, and local economies. Aesthetic resources include visual resources as well as other sensory experiences (i.e. hearing and smelling). The primary purpose of this study is to inventory coastal California recreation and aesthetic resources that may be affected by proposed OCS oil and gas development activities and to evaluate their significance.

60864 (PB—82-193046) Hazardous materials response project: program plan. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Office of Marine Pollution Assessment). Nov 1981. 33p. NTIS, PC A03/MF A01.

The overall purpose of this Program described is to provide timely and effective deployment of scientific resources during an emergency oil or hazardous substance release to minimize environmental and socioeconomic impact.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 60855, 61641, 61649

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 60852, 60853

0230 Properties

REFER ALSO TO CITATION(S) 60717

60865 **(DOE/BETC/PPS—82/3) Motor gasolines, winter 1981-1982.** Shelton, E.M. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Jul 1982. 70p. NTIS, PC A04/MF A01. Order Number DE82021119.

Analytical data for 905 samples of motor gasoline, were collected from service stations throughout the country and were analyzed in the laboratories of various refiners, motor manufacturers, and chemical companies. The data were submitted to the Bartlesville Energy Technology Center for study, necessary calculations, and compilation under a cooperative agreement between the Bartlesville Energy Technology Center (BETC) and the American Petroleum Institute (API). The samples represent the products of 30 companies, large and small, which manufacture and supply gasoline. These data are tabulated by groups according to brands (unlabeled) and grades for 17 marketing districts into which the country is divided. A map included in this report, shows marketing areas, districts and sampling locations. The report also includes charts indicating the trends of selected properties of motor fuels since winter 1959-1960 survey for the leaded gasolines, and since winter 1979-1980 survey for the unleaded gasolines. Sixteen octane distribution percent charts for areas 1, 2, 3, and 4 for unleaded antiknock index (R+M)/2 below 90.0, unleaded antiknock index (R+M)/2 90.0 and above, leaded antiknock index (R+M)/2 below 93.0, and leaded antiknock index (R+M)/2 93.0 and above grades of gasoline are presented in this report. The antiknock (octane) index (R+M)/2 averages of gasoline sold in this country were 87.4 for unleaded below 90.0, 91.7 for unleaded 90.0 and above, and 88.9 for leaded below 93.0. Only one sample was reported as 93.0 for leaded gasolines with an antiknock index (R+M)/2 93.0 and above.

0240 Storage

REFER ALSO TO CITATION(S) 62197

60866 **(DOE/EP—0046/2) Strategic Petroleum Reserve. Quarterly report.** (USDOE Assistant Secretary for Environmental Protection, Safety and Emergency Preparedness, Washington, DC). 16 Aug 1982. 12p. NTIS, PC A02/MF A01. Order Number DE82021752.

During the second quarter of 1982, the Department of Energy continued to expand the storage capacity for the Strategic Petroleum Reserve (SPR) and to take advantage of the favorable international oil market for the purchase of oil to fill the Reserve. The SPR is being developed in three phases and the cumulative fill capability for storage of crude oil for the SPR is expected to be 750 million barrels by 1990. Market conditions continued to be favorable for the purchase of oil to fill available SPR storage capacity. The SPR was filled at a rate of 171,470 barrels per day during the calendar quarter ending June 30, 1982, and the total SPR crude oil inventory at the end of this period was 264,141,247 barrels. The weighted average cost of crude oil delivered to SPR terminals from April 1, 1982, through June 30, 1982, was $34.06 per barrel. The SPR Petroleum Account became off-budget in FY 1982 pursuant to the Omnibus Budget Reconciliation Act of 1981. Funds for storage facilities development and operations, planning and program direction continue to remain on budget. Congress appropriated $3.7 billion to the SPR Petroleum Account for FY 1982. During the third quarter of FY 1982, obligations totaling $2.1 million were made from the Account bringing cumulative FY 1982 obligations for the first three quarters of FY 1982 to $2.666 billion. A total of $239 million is available in FY 1982 for obligations for storage facilities development and operations, planning and program direction. Of this total, $126.1 million have been obligated in the first three quarters of this fiscal year, and a deferral of $52.9 million for the Phase III Big Hill site has been sent to Congress.

0250 Combustion

REFER ALSO TO CITATION(S) 60836, 61741

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 61668

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 61642, 61826

60867 **(CONF-8103113—) Western tight gas sands advanced logging workshop proceedings.** Jennings, J.B.; Carroll, H.B. Jr. (eds.). (USDOE Bartlesville Energy Technology Center, OK). Apr 1982. 260p. NTIS, PC A12/MF A01. Order Number DE82014589.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

Portions of document are illegible.

An advanced logging research program is one major aspect of the Western Tight Sands Program. Purpose of this workshop is to help BETC define critical logging needs for tight gas sands and to allow free interchange of ideas on all aspects of the current logging research program. Sixteen papers and abstracts are included together with discussions. Separate abstracts have been prepared for the 12 papers. (DLC)

60868 (CONF-8103113—, pp 15-25) **Western tight gas sands logging problems.** Carroll, H.B. Jr. (Bartlesville Energy Tech. Center, OK). Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

This paper first points out some of the problems that confront a reservoir analyst as be attempts to make decisions concerning tight and reservoirs. Based on these problems, the goals of the research are derived. Geophysical complications of tight sands are discussed followed by a presentation of research programs on tight sands logging problem. 3 figures.

60869 (CONF-8103113—, pp 26-46) **NMR and flow estimation.** Cowgill, D.F. (Sandia National Labs., Albuquerque, NM); Pitman, J.K.; Seevers, D.O. Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

Samples of fine-grained sandstone and siltstone from the CIGE 21 core, Uinta, Utah, were studied by NMR mineralogy. The size and shape of pores are highly variable. Pore geometry is strongly influenced by illite and chlorite distributed in pore throats and kaolinite as pore fill. The proton resonance signal, nuclear free induction decay, was an accurate measure of the fluid content in saturated samples and, thus, of the producible pore volume. This porosity varied from 1 to 13 percent. The thermal relaxation (T_1 decay) of the proton resonance of a water molecule within a pore is sensitive to the pore's available surface-to-volume ratio (S/V). Permeabilities were calculated from these S/V distributions. The flow measurements yielded permeabilities ranging from <0.001 to 1.6 millidarcies. An alternative network model of the pore system is proposed, which incorporates the observed S/V distributions. Network permeabilities are computed using an effective medium theory and found to be in good agreement with the standard flow measurements. 19 figures.

60870 (CONF-8103113—, pp 56-79) **Inversion of resistivity data using ridge regression techniques.** Warne, L.K. (Sandia National Labs., Albuquerque, NM); Reardon, P.C. Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

The method of Ridge Regression has been applied to a large number of nonlinear parameter estimation problems since the publication of Marquardt's paper. The Ridge Regression technique was applied to the problem of determining the resistivity profile surrounding a wellbore. The data to be inverted are multiple normal apparent resistivity measurements. One of the parameters describing the resistivity profile, the depth of mud filtrate invasion, is of particular interest in tight western gas sand formations. 14 figures.

60871 (CONF-8103113—, pp 99-127) **Pore structure measurements in WTGS.** Duda, L.E. (Sandia National Labs., Albuquerque, NM). Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

A method was developed to digitize and quantify the pore networks of fine-grained rocks using the apparent pore space observed in photographs of thin-sections. By digitizing numerous photographs statistical data were generated, thereby making it possible to address the problem of pore structure. The specimens analyzed were obtained from the CIG Exploration, Inc. Natural Buttes No. 21 core. Data from the digitized pictures were processed to obtain pore size, shape, and directional anisotropy information. Pore sizes as determined by perimeters, areas, and a linear pore length followed a log-normal distribution. Two anisotropy analysis methods were used and both have shown that little directional anisotropy exists in the pore structure of the samples studied. Statistical shape parameters were derived from the measured perimeters and areas of the pores. These suggest that most of the pores within each sample have a tabular rather than tubular shape. 16 figures.

60872 (CONF-8103113—, pp 136-149) **Cation exchange properties of the WTGS.** Volk, L. (Bartlesville Energy Tech. Center, OK). Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

One of the characteristics of the formations of interest within the basins of the WTGS Project Area is the relatively high clay content of the potential producing sands. In this presentation, the influence of the clays on the measurement of formation (electrical) conductance will be briefly discussed. A couple of the shaly sands models designed to account for clay conduction (double-layer potential) will be presented to examine the functional relation of the cation exchange capacity (CEC) to the water saturation, Sw. The procedures used at BETC for studying the interface conductivity will be discussed. Some of the research is concerned with the possible influence of cations other than Na^+ (such as K^+) on obtaining Sw. The influence of other ions, such as Ca^{++} may be far more important than their free concentration in formation waters. Other factors, such as the temperature dependence of the CEC, may influence the use of CEC data in log interpretation. Typical values for the CEC of the primary basins are given. Accordingly, logging in the Northern Great Plains Province should be particularly plagued by clay interference based on their CEC values. Various methods of measuring the CEC have been examined and will be presented. The particular technique to be used depends primarily on the accuracy desired. This presentation will emphasize the research being conducted at BETC. 12 figures.

60873 (CONF-8103113—, pp 150-174) **Density, sonic, and neutron log porosity calculation in the Uinta Basin, Utah.** Osoba, J. (Texas A and M Univ., College Station); Gist, R.; Raible, C. Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

Core and petrographic studies have been made on samples from Lower Tertiary and Upper Cretaceous formations. Results indicate that a carbonate cement has filled much of the original porosity and altered the matrix density. Lower porosity samples tend to be heavily cemented and have matrix densities that approach, and even exceed, 6.68 gm/cc. Higher porosity samples tend to be lightly cemented and have matrix densities that approach 2.65 gm/cc. Log analyses, supplemented by core data, reveal that the higher porosity samples have matrix travel times that approach 55.6 microseconds/ft. The presence of the carbonate cement does not decrease the matrix travel times as expected. Laboratory measured matrix travel times substantiate those conclusions. Log analyses also indicate the neutron log, when calibrated for a sandstone matrix, will correctly evaluate the higher porosity, clean sandstones. For lower porosity sandstones, generally those that are heavily cemented, an increasingly dolomitic calibration is needed. 10 figures, 2 tables.

60874 (CONF-8103113—, pp 194-207) **MWX logging program.** Kukal, G.C. Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

The MWX-1 Logging Program is a comprehensive log suite designed to evaluate tight gas sandstones. A unique feature is its two mud system design which is necessitated by the extensive coring of this well. Logs will first be run in oil. The hole will then be reamed, circulated with a fresh-water mud system, and relogged. The log suite consists of conventional logging tools in addition to developmental and experimental tools. The more exotic logs included in the suite are Multifrequency Induction, Litho Density, Spectral Gamma, NML, Borehole Televiewer, Circumferential Microsonic, Dielectric Constant Log, Carbon/Oxygen Log and Electromagnetic Propagation Log. Procedures that will be followed during logging will be those in accordance with the WGSP Log Quality Control Checklist. Extensive repeat sections will be run on all radioactivity-type logs. There will be a concerted effort to record as much raw data as possible. Included will be measurements such as count rates, sonic wave trains, free precession decay and photographs of neutron-gamma spectrum buildups. All data including raw data will be recorded on magnetic tape. Dipmeter will be processed using Standard Cluster and Geodip. Mechanical properties logs will be generated using direct measurements from the shear wave. LOGCALC computer programs will be utilized for computer log analysis.

60875 (CONF-8103113—, pp 208-234) **Core-log correlations in the multi-well experiment.** Sattler, A.R. (Sandia National Labs., Albuquerque, NM). Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

A comprehensive core analysis program will be conducted involving 7500 feet of core from the Mesaverde formation, portions of which will be oriented, and limited amounts of pressure core. Special features include: (1) a core gamma log in the field to correlate log and core depths, (2) taking of plugs for screening analyses, (3) measurement of dip and strike of core features with a special instrument, (4) core field processing in an all-weather facility at the site, (5) use of an oil-base mud for improved core recovery and hole stability, and (6) a MWX core library to be at Grand Junction, Colorado. This work will provide significant understanding of the synergisms among categories of core analyses and core-log correlation. Core-log correlations will proceed on three different levels, basic, empirical and advanced (research). These levels correspond respectively with the tracks of core analyses. The simple level will be almost a field type correlation, log with core depth and elementary log lithologic indicators with core analyses. The empirical level will involve correlations from established relations with measurement of those parameters from core. Correlations on the research level differ because of the need to start from basic principles to develop a more inclusive set of relations which results in the development of new tools and lab techniques. The MWX core-log correlations will also include some relatively new applications with certain established logging devices.

60876 **(METC/EGSP—501) Southern tie section: a stratigraphic section through the Devonian-Mississippian blackshale sequence in Ohio, Kentucky, West Virginia, and Virginia.** Wilson, E.N.; Zafar, J.S.; Ettensohn, F.R. (Kentucky Geological Survey, Lexington (USA). Dept. of Geology; Kentucky Univ., Lexington (USA). Research Foundation). 1981. Contract AC21-76ET12040. 44p. NTIS, PC A03/MF A01. Order Number DE82021970.

The map of the Southern Tie Section is a sequel to the Preliminary Stratigraphic Cross Section of Kepferle, Wilson, and Ettensohn (1978) and uses many of the datum points of that publication. Sample descriptions and other geophysical log curves in addition to the gamma ray (natural radioactivity) curve are used for correlation; and the geology of the substrates of the shale sequence is examined for its relation to that of the sequence itself. The section uses the Base of the Sunbury shale (rather than the base of the shale sequence) as the stratigraphic datum in order better to visualize syndepositional and earlier tectonism which affect the distribution and internal constitution of the sequence. This convention shows elegantly the onlap of the sequence upon the Cincinnati Arch, but does not so readily point out the meaning of the Wildcat Valley Sandstone in the Greendale Syncline at the southeast end of the section.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 61858

0304 Products And By-products

60877 **(INPE—2214-PRE/014) Helium production in natural gas reservoirs.** Pereira, E.B.; Adams, J.A.S. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Aug 1981. 14p. NTIS, PC A02/MF A01.

About 11,000 published natural gas analyses for helium were used in the estimation of the average global scale accumulation and concentration of radiogenic helium in sediments. Simple lognormal statistics are employed to derive a net accumulation rate between 1,000,000 to 670,000 helium atoms per cubic meter of reservoir rock per second. This accumulation rate permits an inference of an average helium concentration of non-reservoir sediments of about 67 ppm. By assuming a simple closed system model, it is shown that deep seated sources of helium are not necessary to explain the present regime of helium in sediments on a global scale, and that the accumulation rate and concentration obtained are in close agreement with existing fundamental geochemical estimates of uranium and thorium in rather average type of sediments.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 60859, 62051

60878 **(PB—82-214321) Economic theory of enhanced natural gas service to the industrial sector. Final interim report Oct 80-May 81.** Cicchetti, C.J.; Kirsch, L.D.; Shaughnessy, R. (Madison Consulting Group, WI (USA)). May 1981. 96p. NTIS, PC A05/MF A01.

Future United States natural gas demand depends on the quality of natural gas service to industrial users. This interim report synthesizes and develops rules by which the economic efficiency of various improvements may be analyzed. Specifically, the rules indicate the cost and demand conditions under which different combinations of transmission activity, storage activity, peak-shaving production, and interruptions are efficient. The report also presents economic theory with which considerations of national security, the environment, balance of payments, and certain institutional factors may be brought into the analysis of gas service quality.

0307 Waste Management

REFER ALSO TO CITATION(S) 61966

0308 Environmental Effects

REFER ALSO TO CITATION(S) 60861, 60862, 60863

60879 **(UCRL—87668) LNG vapor-dispersion research at LLNL: remaining questions.** Ermak, D.L. (Lawrence Livermore National Lab., CA (USA)). May 1982. Contract W-7405-ENG-48. 16p. (CONF-820378—1). NTIS, PC A02/MF A01. Order Number DE82015922.

From Gas Research Institute workshop on vapor dispersion; Cambridge, MA, USA (23 Mar 1982).

The major findings of the LNG vapor dispersion research carried out by LLNL are briefly described. The experiments have provided considerable insight into the importance of such heavy gas dispersion phenomena as gravity spreading and cloud-induced turbulence, and have also provided a number of experiments for model validation. The predictions of three vapor dispersion models for cold dense gas releases were compared with experimental results. Recommendations for further research to elucidate the effects of gravity spreading and ground heating on the dispersion of the LNG vapor cloud including the scaling of these phenomena with spill size are presented. (ACR)

60880 **A survey of discharges from a natural gas drilling operation in Lake Erie.** Parker, J.I.; Ferrante, J.G. *Environmental Science and Technology;* **16**: No. 6, 363-367(Jun 1982).

We mapped turbid discharge plumes from a Canadian gas drilling rig by continuous-flow nephelometry and measured the concentrations of selected inorganic and organic constituents in the plumes. The buoyant surface plumes were from ~600 to 1500 m long, with a maximum width of ~250 m and areas less than 25 ha. Maximum total suspended solids in the discharge plumes were usuallly less than 5.0 mg/L and were rapidly dispersed when discharging ceased. Sodium, magnesium, sulfate, and chloride were diluted to ambient lake-water levels within 50 m of the drilling rig. Volatile hydrocarbons were <25 μg/L and dispersed quickly. Methane and ethane were enriched in the discharge plume but dispersed rapidly with increasing distance from the rig.

0309 Artificial Stimulation

60881 (CONF-8103113—, pp 1-13) **Overview: the Western Tight Gas Sands program.** Crawley, A.B. (Bartlesville Energy Tech. Center, OK). Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

The three small kidney-shaped basins in the Rocky Mountain area are the focus of this program. Early attempts to stimulate gas from Piceance are described and the funding of the program discussed briefly. Characterization work on hydraulic fractures and proppant behavior studies are also discussed. 10 figures. (DLC)

60882 (CONF-8103113—, pp 175-183) **Department of Energy's Western Gas Sands project multi-well experiment.** Northrop, D.A. (Sandia National Labs., Albuquerque, NM). Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

The Department of Energy has initiated a Multi-Well Experiment whose objectives are: (1) characterization of low permeability, lenticular gas sands and (2) evaluation of state-of-the-art and developing technology for their production. A site has been acquired in the Rulison Field in the Piceance Basin (S34, T6S, R94W, Garfield Co., Colo.). The lenticular Mesaverde sequence and the underlying blanket Corcoran-Cozzette are the formations of interest and lie at depths between 4000 and 8600 ft. Features of this research-oriented field experiment include: (1) three close-spaced wells (100 to 500 ft) for reservoir characterization, conventional well tests, interference testing, well-to-well geophysical profiling, and placement of diagnostic instrumentation adjacent to fracture treatments; (2) complete core taken through the formations of interest; (3) a comprehensive core analysis program; (4) an extensive logging program featuring conventional and experimental logs; (5) determination of in-situ stress in sand lenses and bounding shales; (6) application of geophysical techniques to determine sand lens orientation; (7) use of seismic, electrical potential, and tilt diagnostic methods for hydraulic fracture characterization; and (8) a series of stimulation experiments. Analysis of data from these activities will yield the following kinds of information: (1) geologic characterization emphasizing the morphology, properties, and variability of lenticular sands; (2) a reservoir model for lenticular sand production; (3) a fracture model including correlations between stress, geometry, and lens orientation; (4) core-log-well test correlations for im-

proved formation evaluation; and (5) economic assessments. 4 figures.

60883 (CONF-8103113—, pp 184-193) **Multi-well experiment operations.** Mann, R.L. Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

The first well, MWX-1, will be cored from the top of the Mesaverde at 3950 ft to the base of the Corcoran at 8504 ft. At 6500 ft an interim suite of logs will be run. Present plans are to drill MWX 2 and -3 in a similar manner. The closely spaced wells will be used as observation wells during the fracture treatment and also as pressure monitoring wells during the pre- and post-stimulation testing.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 61641, 61646, 61649

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 60878

0340 Combustion

REFER ALSO TO CITATION(S) 61752

0350 Storage

REFER ALSO TO CITATION(S) 62197

60884 (DOE/EIA—0239(81-82)) **Underground natural gas storage in the United States, 1981-1982 heating year (April 1981-March 1982).** Koelling, G.W.; Kiedrowski, J.; Hinton, D. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Aug 1982. 38p. NTIS, PC A03/MF A01. Order Number DE82021217.

This edition is the third in a series of annual reports on the Nation's underground natural gas storage. The report provides information on the operations, capacity, and location of underground natural gas storage facilities to a wide audience including industry, consumers, government agencies, and educational institutions. As of March 31, 1982, the end of the 1981 to 1982 heating year, the 402 active underground storage reservoirs in the United States contained 5355 billion cubic feet of natural gas (Table 1). Of this total, approximately 70.1% was base, or cushion, gas, and 29.9% was working gas. The volume of the latter is usually built up by injecting gas into storage when market requirements are below available gas flow in transmission lines during the nonheating portion (April 1 through October 31) of the heating year. Net injections during the nonheating portion of the 1981 to 1982 heating year of 1685 billion cubic feet were 15.3% of total dry gas production excluding nonhydrocarbon gases during the same period. Net withdrawals during the 1981 to 1982 heating season of 1618 billion cubic feet (Table 2) were equivalent to 16.5% of total estimated gas consumption during the same period. Working gas in storage at the end of the 1981 to 1982 heating year totaled 1601 billion cubic feet, approximately 1.8% below that available at the beginning of the heating year. This decline, despite an excess of storage injections over withdrawals (net injections) of 67 billion cubic feet during the heating year, was the result of book transfers from the working gas to base gas category. The volume of base gas in storage increased 2.7% to 3754 billion cubic feet. As of March 31, 1982, the 88 companies known to operate active underground storage facilities (see Appendix B) reported a total of 402 storage reservoirs with a combined capacity of 7829 billion cubic feet.

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 61661

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 60713, 60890

60885 (DOE/LC/10036—T11) **Occidental vertical modified in-situ process for the recovery of oil from oil shale: Phase II. Final report, June 1, 1979-August 31, 1981.** (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Mar 1982. Contract FC20-79LC10036. 145p. NTIS, PC A07/MF A01. Order Number DE82018560.

Phase II of the Cooperative Agreement between the Department of Energy (DOE) and Occidental Oil Shale, Inc. (OOSI) has the primary objective of simultaneously processing two commercial-size modified in situ (MIS) retorts. Most of the data obtained from this program will appear in the Summary Report to be issued six months after the completion of Phase II. This Final Report summarizes the progress of the project through August 19, 1981, the effective data of the DOE discontinuance of funding. As agreed under Modification 014 to the Agreement, there will be no reports between this Final Report and the Summary Report. Through the Discontinuance, the work covered in Phase II include: mining for, and formation of, Retorts 7, 8, and Room 8X (R7, 8, and 8X); construction of processing facilities; installation of mine stability and processing instrumentation; collection and analysis of a R7 and 8 core; execution of a mini-retort blast and ignition test program; and continuous environmental support.

60886 (SAND—81-2122) **Resistive heating for oil-shale retorting.** Schamaun, J.T.; McAniff, R.J.; Warne, L.K. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01. Order Number DE82021296.

Since 1941, researchers have explored the use of electrical energy to convert oil shale into usable liquid fuels. The attractiveness of these electrical methods stems from the fact that they allow for true in-situ processing. One specific method that appears to hold promise is electrical resistive heating. In this method, heat is induced from an electrical-power input at two spatially separated electrodes. As retorting begins, the electrical resistivities of the shale formation are expected to increase dramatically. This in turn allows the power input to be focused primarily at the retort zone. To explore the feasibility of this method, the thermal response of the shale to electrical inputs is calculated analytically and also numerically through a finite-element formulation. Results and limitations of the research, as well as a set of recommendations are included in this report.

60887 (UCID—16986-82-2) **Lawrence Livermore National Laboratory oil shale project. Quarterly report, April-June 1982.** Carley, J.F. (ed.). (Lawrence Livermore National Lab., CA (USA)). 14 Sep 1982. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01. Order Number DE83000503.

The effect of the proportion of oxidized shale to raw shale, on the heat of combustion of retort product was studied in a fluidized sand bed at 500°C. Results show a significant increase in the heat of combustion, produced by the activity of the oxidized shale. The functionality of organic sulfur in various oil shale types is being investigated. An oil shale pyrolyzer for aboveground retorting is being studied in an engineering facility. Thermochemical and experimental equations were developed for the heat of combustion of raw shale. A heat balance was calculated for 24.6 gal/ton Colorado oil shale. The rapid-pyrolysis data was analyzed to determine the best kinetic scheme for retort modeling. Incipient fluidization velocity measurements were made for various crushed oil shale mixtures of different particle sizes. 10 figures, 1 table. (DLC)

0405 Properties And Composition

REFER ALSO TO CITATION(S) 60894, 60912, 61840

60888 (DOE/EV/10298—4, pp X.1-X.68) **Inorganic constituents in oil shale.** Runnells, D.D.; Esmaili, E. (Univ. of Colorado, Boulder). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

Disposal of large amounts of waste oil shale is one of the most important problems associated with a commercial oil shale industry. The possibility of contamination of natural waters in northwestern Colorado by chemical constituents leached out of the waste shale is also a matter of concern. This report deals with the chemical and physical interactions between potential leachates from Tosco-II shale with the indigenous soils and bedrock materials that underlie probable disposal sites in the Piceance Creek Basin. Our objective is to determine the reactivity and capacity of the natural geologic materials of the region for removing and retarding dissolved contaminants in leachate from the Tosco-II shale. Piceance Creek Basin soils and subsurface materials provide a good buffering capacity and strongly absorb As and Al from leachates. However, there is very little retardation of Mo, B, Cl or SO_4. F is retarded, but not irreversibly. High levels of Na in leachates leads to occupation of exchange sites in clay minerals by Na and a subsequent dispersion of soil particles. The data on As and Al indicate that these contaminants will at least not be a short-term concern. The data on Cl and SO_4 suggest these as good candidates for tracers of leachate movement. The phenomenon of dispersion (peptization) due to exchange of Na for other cations could lead to an increase in surface runoff and a potential for physical instability.

60889 (UCID—19547) **Raman/FTIR spectroscopy of oil shale retort gases.** Richardson, J.H.; Monaco, S.B.; Sanborn, R.H.; Hirschfeld, T.B.; Taylor, J.R. (Lawrence Livermore National Lab., CA (USA)). Aug 1982. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01. Order Number DE82021011.

A Raman facility was assembled in order to aid in the evaluation of the feasibility of using Raman or FTIR spectroscopy for analyzing gas mixtures of interest in oil shale. Applications considered in oil shale research included both retort monitoring and laboratory kinetic studies. Both techniques gave limits of detection between 10 and 1000 ppM for ten representative pertinent gases. Both techniques are inferior as a general analytical technique for oil shale gas analysis in comparison with mass spectroscopy, which had detection limits between 1 and 50 ppM for the same gases. The conclusion of the feasibility study was to recommend that mass spectroscopic techniques be used for analyzing gases of interest to oil shale.

60890 **Biological markers from Green River kerogen decomposition.** Burnham, A.K.; Clarkson, J.E.; Singleton, M.F.; Wong, C.M.; Crawford, R.W. (Lawrence Livermore Lab., CA). *Geochimica et Cosmochimica Acta;* **46**: No. 7, 1243-1251(Jul 1982). Contract W-7405-ENG-48.

Isoprenoid and other carbon skeletons that are formed in living organisms and preserved essentially intact in ancient sediments are often called biological markers. The purpose of this paper is to develop improved methods of using isoprenoid hydrocarbons to relate petroleum or shale oil to its source rock. It is demonstrated that most, but not all, of the isoprenoid hydrocarbon structures are chemically bonded in kerogen (or to minerals) in Green River oil shale. The rate constant for thermally producing isoprenoid, cyclic, and aromatic hydrocarbons is substantially greater than for the bulk of shale oil. This may be related to the substantial quantity of CO_2 which is evolved coincident with the isoprenoid hydrocarbons but prior to substantial oil evolution. Although formation of isoprenoid alkenes is enhanced by rapid heating and high pyrolysis temperatures, the ratio of isoprenoid alkenes plus alkanes to normal alkenes plus alkanes is independent of heating rate. High-temperature laboratory pyrolysis experiments can thus be used to predict the distribution of aliphatic hydrocarbons in low temperature processes such as in situ shale oil production and perhaps petroleum formation. Finally, we demonstrate that significant variation in biological marker ratios occurs as a function of stratigraphy in the Green River formation. This information, combined with methods for measuring process yields from oil composition, enables one to relate time-dependent processing conditions to the corresponding time-dependent oil yield in a vertical modified-in situ retort even if there is a substantial and previously undetermined delay in drainage of shale oil from the retort.

60891 **^{13}C NMR measurements of the genetic potentials of oil shales.** Miknis, F.P. (Laramie Energy Tech. Center, WY); Netzel, D.A.; Smith, J.W.; Mast, M.A.; Maciel, G.E. *Geochimica et Cosmochimica Acta;* **46**: No. 6, 977-984(Jun 1982).

Cross polarization, magic-angle spinning ^{13}C NMR measurements have been made on raw oil shales that represent a variety of geologic ages, origins, depositional environments and source locations. A high degree of correlation was established between the fraction of aliphatic carbon measured by ^{13}C NMR, and the genetic potential, calculated from Fischer assay data. The correlation is independent of the type of kerogen in the raw shale, and its degree of evolution. A short discussion on the validity of various correlations between physical/chemical properties of oil shales and Fischer assay oil yields is given.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 60892

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 60897, 60898, 60907, 60908

60892 (DOE/EV/10298—3, pp XI.1-XI.22) **Characterization and treatment of organic compounds in wastewater from oil shale processing.** Sievers, R.E.; Stanley, J.S.; Conditt, M.K.; Hawthorne, S.B.; Caolo, M.A.; Barkley, R.M. (Univ. of Colorado, Boulder). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

Organic and inorganic compounds present in oil shale wastes require careful characterization and study in order to evaluate the pollution and health problems that would be associated with the release of these materials to the environment. The research described in this report was undertaken to characterize the organic materials present in various oil shale wastewaters, to investigate the potential for mobilization of toxic metals by organic compounds and to make laboratory studies of several proposed wastewater treatment schemes. The significant results and conclusions of this research are: the identification of nitrogen-containing organic compounds, polynuclear aromatic hydrocarbons, phenols, organic acids, hydrocarbons and others, some of which are toxic and mutagenic chemicals; the complexing ability of some wastewater correlates with the dissolved organic carbon concentration of the hydrophobic and hydrophilic fractions of wastewater; the metal complexing ability of wastewater decreases in the order, above-ground retort is much greater than in-situ retort, which is greater than that from a modified in-situ retort; arsenic (primarily H_3AsO_4) is removed from wastewater by percolation through retorted shale; color and odor of in-situ retort waters are reduced by treatment with spent shale; on a laboratory scale, steam-stripping is a relatively effective treatment for removing NH_3, but is less so for volatile organic compounds; as much as 95% of the nitrogen in wastewater is present as recoverable ammonia and 5% is contained in organic compounds; oxidative treatment methods are probably necessary to destroy many hazardous organic compounds present in wastewater; compounds volatilized from retort water are sources of organic air pollutants; and several important analytical methods have been developed and improved during the course of this research.

60893 (DOE/EV/10298—4, pp VIII.1-VIII.32) **Long term stability aspects of spent oil shale waste management.** Nelson, J. (Colorado State Univ., Fort Collins). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

The large amounts of spent shale will be disposed of by construction of large waste dumps on a scale similar to or larger than the largest mining operations in North America. Some dumps are projected to be as high as 800 or 900 feet. Several unique properties of spent shale, such as water content, the potential for heat generation in the dump, and the constitutive properties at high stress levels, point towards the need for careful design and evaluation of waste management plans. This report discusses the general magnitude and nature of the waste management plans. Scenarios for disposal of spent shale are discussed and areas in which research is needed are presented. Measurements of the effect of confining stress on the degree of saturation indicate the potential for saturated zones to exist near the bottom of the pile. An analysis of the potential for wetting fronts to impact such a saturated zone indicates that the period required for infiltration water to reach the saturated zone would be 100 years or less. The existence of a saturated zone at the bottom of a pile could have significant effects on the transport of solutes and, perhaps, stability. If infiltration water is added to the saturated zone, this water may cause perched mounds to develop or a rise in the original water table or, at a minimum, an increase in the degree of saturation in zones within the pile.

60894 (DOE/EV/10298—4, pp XI.1-XI.40) **Characterization and treatment of wastewater from oil shale processing in Colorado.** Conditt, M.K.; Hawthorne, S.B.; Barkley, R.M.; Sievers, R.E. (Univ. of Colorado, Boulder). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

Steam stripping of the wastewater is a treatment method likely to be employed which is intended to remove ammonia, hydrogen sulfide, and other volatile compounds from the wastewater. During the exposure of the wastewater to the steam, the possibility exists of removing some of the more volatile organic compounds, thus reducing the organic content of the wastewater. Another matter that should be considered in disposing of the water is the presence and removal of arsenic, a toxic trace element. We have demonstrated that it is possible to adsorb the arsenic in wastewater onto spent shale, thus preventing or retarding its mobilization. This possible treatment method may be useful when considering the co-disposal of spent shale with oil shale wastewaters. The objectives of this research were four-fold: (1) to determine the effectiveness of steam stripping treatment to remove volatile organics from oil shale wastewater; (2) to examine the removal of arsenic from wastewaters upon exposure to spent shale and to determine whether the adsorption is reversible; (3) to develop rapid and effective analytical methodology for the determination of nitrogen heterocycles and aromatic amines in a complex wastewater; and (4) to further characterize oil shale wastewaters for the presence of N-containing compounds, trace elements, and sulfur species. These methods of wastewater treatment were examined and the results of that investigation are presented in this report. (DMC)

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 60885, 60892, 62544, 62545

60885 **(DOE/EML—406) Evaluation of the potential radiological impact of oil-shale development.** Gogolak, C.V. (Department of Energy, New York (USA). Environmental Measurements Lab.). Jul 1982. 33p. NTIS, PC A03/MF A01. Order Number DE82021873.

The radionuclide content of various oil shales, shale oils and retorting waste products has been studied to determine the extent to which the development of this energy resource may perturb the natural radiation environment. Nearly all of the radioactivity in the raw shale is found in the spent shale after retorting. The primary exposure pathway to the public for this radioactivity will be through the release of particulate matter to the atmosphere during various mining, crushing and retorting operations. Since the activity of this material is close to that of normal soil, however, the expected radiological impact is small.

60886 **(DOE/EV/10298—3) Oil shale environmental research and coordination. Progress report, 1979-1982.** Chappell, W.R. (Colorado Univ., Denver (USA). Center for Environmental Sciences). 1982. Contract AC02-79EV10298. 363p. NTIS, PC A16/MF A01. Order Number DE82020755.

Portions of document are illegible.

The purpose of this research program is two-fold: to conduct research on the environmental impacts of an oil shale industry and to develop strategies to mitigate these effects; and to assist the Department of Energy in the field coordination of the oil shale environmental research program. The environmental research program has focused primarily on a comprehensive study of the sources, release mechanisms, transport, fate, and effects of toxic trace substances, principally the trace elements, in an oil shale industry. Separate abstracts have been prepared for individual scientific reports for inclusion in the Energy Data Base. (DMC)

60887 (DOE/EV/10298—3, pp III.1-III.40) **Effect of microbial oxidation of thiosulfate on water quality in oil shale processing operations.** Brierley, C.L.; Brierley, J.A. (New Mexico Bureau of Mines and Mineral Resources, Socorro, NM). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

There is evidence that microorganisms are present in the retort waters, and that these organisms could be responsible for alteration of the water quality. The objectives of the microbiological phase were designed to provide information necessary for evaluation of a system's potential for generation of acid pollution and mobilization of toxic elements by biological processes. The objectives were as follows: to determine the presence of sulfur and polysulfide-oxidizing bacteria. Samples examined included: (1) oil shale leachate having a high thiosulfate concentration; (2) ground water from an oil shale area; (3) shale and soil specimens; (4) downstream specimens from an effluent discharge point; and (5) retort water; to assess by systematic laboratory study the physico-chemical conditions which affected microbial oxidation of sulfur compounds associated with oil shale; to assess the microbially-mediated mobilization of toxic metals; to examine the potential for using sulfur-oxidizing microorganisms for restoration of retort waters. Results of progress are reported for the period 1979-1982.

60888 (DOE/EV/10298—3, pp IV.1-IV.36) **Environmental effects on microbial mobilization of arsenic from retorted oil shale.** Klein, D.A. (Colorado State Univ., Fort Collins); Hassler, R.A.; Meglen, R.R.; Sistko, R. 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

In the first three years of this study, the effects of microbial activity on the mobilization of arsenic (and to some extent selenium) have been studied, in relation to better understanding the role of the independent variables of shale type, added arsenic forms, nutrient presence, oxygen presence, and microorganisms in arsenic mobilization dynamics. Microorganisms carry out important functions in the global cycles for arsenic. Oil shale is of particular environmental interest, due to the higher levels of arsenic found in this material, with values in the range of 60 ug/gm having been reported. During the retorting process, the major portion of the arsenic found in shales appears to remain in the residual solid material and only minor amounts will be released to the retort waters. The presence of organic matter with sufficient available moisture may lead to increased microbial activity and changes in the form and/or mobility of arsenic. Possible effects of microorganisms on the solubilization oxidation, reduction, or alkylation of arsenic have been documented. The present studies were carried out to provide information which would assist in better understanding the effects of changes in critical independent variables on arsenic mobilization. In addition, it was hoped that this information will make it possible to develop initial scenario of arsenic dynamics during the reclamation of retorted shale and other energy-related materials. A major objective was to provide information which could assist in better understanding arsenic dynamics after co-disposal of retort process waters.

60899 (DOE/EV/10298—3, pp V.A1-V.A13) **Adsorption of mercury by soils from oil shale development areas in the Piceance Creek basin of northwestern Colorado.** Klusman, R.W.; Matoske, C.P. (Colorado School of Mines, Golden). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

The retorting of oil shale by surface or in-situ methods will volatilize most of the mercury present in the oil shale. The proposed development of a large scale oil shale industry in the Piceance Creek basin of northwestern Colorado and adjacent areas of the Uinta basin of northeastern Utah may result in significant atmospheric emissions of mercury. The present study was initiated to determine the ability of native soils of the Piceance Creek basin to adsorb low levels of mercury vapor over long periods of exposure. Soils of the Colorado oil shale area exposed to low levels of mercury vapor over extended periods adsorb large quantities of mercury. The adsorption is a dynamic process and desorption occurs if exposure is terminated or the vapor phase concentration is reduced. The capacity of the soils to adsorb mercury and the rate of adsorption is strongly influenced by the amount of amorphous oxides, reducible iron and manganese, and surface area of the soil. These properties are influenced by vegetative cover and to a lesser extent parent material. The emission of mercury from a large oil shale industry may pose a serious environmental hazard. A large variability in mercury concentrations in environmental sinks can be expected depending on meteorological dispersion, soil character, and vegetation type. Concentrations in flora and fauna will be determined by availability of the soil-adsorbed mercury, ability of plants to adsorb mercury, and preferred habitat and forage of the animal population. Although the mercury emission rates might be expected to be relatively constant, observed distributions in sinks can be expected to be complex and possibly exhibit seasonal variation.

60900 (DOE/EV/10298—3, pp V.B1-V.B26) **Concentration of chemical elements in plants growing on retorted oil shale.** Klusman, R.W.; Rice, J.A. (Colorado School of Mines, Golden). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

In 1977, Colorado State University initiated a project for the long-term study of reclamation practices on spent oil shale in the Piceance Creek basin of northwestern Colorado. As part of the work at this Intensive Study Site, a study of plant succession over retorted oil shale was initiated. This plot consisted of different depths and types of soil cover over retorted shale which was then seeded with different plant mixtures and different levels of fertilization. The trace element composition of various species of plants from this plot were determined during the 1979 and 1980 growing season. The objectives of the study are to continue the evaluation of trace element uptake of selected plant species on the revegetation panels at the Intensive Study Site. The 1981 collection represents the third year of collection and should allow the beginnings of the discernment of compositional trends as plant roots begin to penetrate spent shale below the soil cover. In addition to the collections on the revegetation panels, native plant samples of the same species were collected outside the fence in order to tie the revegetation panel compositions to the baseline composition of the region. Soil samples were also collected at these sites. The following elements were determined in Indian ricegrass, Sherman's big bluestem, Utah sweetvetch, winterfat, fourwing saltbush, and western wheat grass: calcium, magnesium, potassium, copper, zinc, aluminum, boron, fluorine, and molybdenum. (DMC)

60901 (DOE/EV/10298—3, pp V.C1-V.C37) **Geochemical baseline studies in the Uinta Basin, Utah.** Klusman, R.W.; Rice, J.A.; Brown, D.G. (Colorado School of Mines, Golden). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

Trace element composition is evaluated for stream sediments from the eastern Uinta Basin, Utah, which will provide data analogous to that developed by Ringrose for the Piceance Basin. These stream sediments are pre-development baseline samples from the portion of the Uinta Basin east of the Green River. The area includes the Prototype Lease Tracts U-a and U-b, as well as the various corporate owned and leased sites proposed for development in Utah. Geochemical baselines are conducted for surface soils and plants from the eastern Uinta Basin. Plant materials are analyzed from the Intensive Study Site. Specimen are analyzed for: molybdenum, copper, zinc, fluorine, boron, mercury and organic carbon.

60902 (DOE/EV/10298—3, pp VI.A1-VI.A17) **Elemental contents of plants growing on soil-covered retorted shale.** Schwab, A.P. (Colorado State Univ., Ft. Collins); Lindsay, W.L.; Smith, P.J. 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

The concentrations of several potentially toxic elements (F, B, Mo, Pb, Ni, Co, Cd, Cr, Hg, Se, and As) were determined in plants growing on various depths of soil covering retorted (Paraho) shale. The plants that were sampled include: Indian ricegrass (Oryzopsis hymenoides), fourwing saltbush (Atriplex canescens), western wheatgrass (Agropyron smithii), Sherman's big bluegrass (Poa ampla), Utah sweetvetch (Hedysarum boreale) and winterfat (Ceratoides lanata). The F levels were elevated in some of the plants growing on 30 cm of soil over shale. The concentrations of Mo and the Cu:Mo ratios in the plants indicate that molybdenosis could be expected with livestock grazing on revegetated plants. Increasing the depth of soil cover reduced the Mo levels, but the second year's data indicate that increasing the soil depth may only temporarily reduce the potential molybdenosis problem. The plant levels of Pb, Co, Cd, and Hg were below analytical detection limits. The plant concentrations of Ni, As, Se, B, and Cd were too low to be of environmental concern.

60903 (DOE/EV/10298—3, pp VI.B1-VI.B16) **Boron toxicity in range plants grown on retorted oil shale.** Smith, P.J.; Lindsay, W.L. (Colorado State Univ., Ft. Collins). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

During the last year an effort has been made to determine the critical tissue level of boron (B) of several range plant species that will cause reduction in dry matter production. In addition, data was obtained which correlates plant uptake of B with 1N NH_4Ac extractable B from a surface soil from the Piceance Creek Basin in Colorado and Tosco retorted shale. Plant, soil, and shale levels of B corresponding to a 10% depression yield have been established. An important parameter of forage quality, the copper to molybdenum ratio, was also evaluated for plants grown on both soil and Tosco shale. This study has shown that for 4 of the 5 species of plants grown on retorted Tosco oil shale, the B levels in the plants were below that associated with a 10% reduction in yield. Addition of B to the shale resulted in increased B in the plants. The levels of B in plants growing on retorted Tosco shale which permitted 90% of maximum growth were: Alkali Sacaton 262 ppM, fourwing saltbush 90 ppM, Lewis flax 104 ppM, tall wheatgrass 366 ppM, and Western wheatgrass 569 ppM. The corresponding levels of NH_4Ac-extractable B from the B-treated Tosco shale were 7.2 ppM for alkali sacaton, 7.2 ppM for fourwing saltbush, 0.74 ppM for Lewis flax (no growth on shale), 10.2 ppM on tall wheatgrass, and 8.5 ppM on Western wheatgrass. This study demonstrates that boron is most likely not limiting plant growth on processed Tosco Oil Shale except possibly for Lewis flax. The very low Cu/Mo ratio of plants growing on processed Tosco shale strongly suggest that molybdenosis will be a problem for ruminants grazing the area.

60904 (DOE/EV/10298—3, pp IX.1-IX.50) **Transport and release mechanisms of soluble pollutants from spent oil shales.** Ramirez, W.F. (Univ. of Colorado, Boulder). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

The purpose of this study is to systematically study transport and release mechanisms of soluble pollutants from spent oil shales. Porous media properties of spent shales are investigated. These include: mercury intrusion porosimetry; nitrogen adsorption isotherms; and scanning electron microscopy. Transport properties and dynamic leaching of soluble pollutants from spent shales are determined. A mathematical model based on the spent shales characterization study is presented. (DMC)

60905 (DOE/EV/10298—3, pp X.1-X.16) **Interaction of oil shale-related leachates and natural geologic materials.** Runnells, D.D.; Esmaili, E. (Univ. of Colorado, Boulder). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

Our objective over the past several years has been to study the chemistry of interaction among water, waste oil shales, soils, and bedrock from the Piceance Creek Basin. It is essential to understand the chemistry of potential leachates in order to control and mitigate the environmental impact in the event that such leachates are generated in field disposal piles. In this report we summarize the most important and relevant aspects of our work. In the early phases of our work we focused on the concentrations and mechanisms of release of a wide variety of dissolved potential contaminants in aqueous leachates. More recently we have been studying the chemical and physical interactions between oil shale leachate and the soils and bedrock that lie adjacent to various proposed disposal sites at the Colony Development location. It was found that: the composition of leachates depends on original mineralogy of raw shale, retorting conditions, conditions of leaching, prior history of wetting and drying raw shale; capillary salts on the surface of spent shales are chiefly sodium sulfates combined with many other species; most dissolved species rinse out rapidly with the notable exception of F which is controlled by secondary solid fluorite; the original residence of F in those oil shales investigated is illite; and dissolved Ca exerts a strong control over F and, possibly, As. Significantly higher concentrations of As (1.5 mg/L) than normal were seen in a leachate where Ca was depressed by precipitation of calcium carbonate. The source of high carbonate was probably dawsonite or nahcolite. The surface area of spent shales has a negative charge explaining the mobility of F. The negative charge is probably due to residual carbon.

60906 **(DOE/EV/10298—4) Oil shale environmental research and coordination. Progress report, 1981-1982.** Chappell, W.R. (Colorado Univ., Denver (USA). Center for Environmental Sciences). 1982. Contract AC02-79EV10298. 351p. NTIS, PC A16/MF A01. Order Number DE82020762.

Portions of document are illegible.

The purpose of this research program is two-fold: to conduct research on the environmental impacts of an oil shale industry and to develop strategies to mitigate these effects; and to assist the Department of Energy in the field coordination of the oil shale environmental research program. The environmental research program has focused primarily on a comprehensive study of the sources, release mechanisms, transport, fate, and effects of toxic trace substances, principally the trace elements, in an oil shale industry. The study group is a multi-institutional, interdisciplinary team from the University of Colorado, Colorado State University, the Colorado School of Mines, and the New Mexico Institute of Mining and Technology. Separate abstracts have been prepared for individual reports for inclusion in the Energy Data Base. (DMC)

60907 (DOE/EV/10298—4, pp III.1-III.16) **Microbial thiosulfate oxidation and its effect on the quality of water in oil shale retorting.** Brierley, J.A.; Brierley, C.L. (New Mexico Inst. of Mining and Tech., Socorro). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

The objectives of the study were: (1) to pursue environmentally-related investigations on the production of acid resulting from biologically-mediated thiosulfate oxidation on process waters and other thiosulfate-contaminated waters resulting from oil shale retorting; and (2) to apply bacterial thiosulfate oxidation to restoration of retort waters. Results indicate that both naturally occurring microflora and an introduced bacterium were capable of respiring on raw and retorted oil shale and oxidizing thiosulfate. However, less activity is found on raw shale. Thiosulfate-oxidizing T. novellus was able to respire in presence of OXY-6 process water, but respiration was enhanced by dilution with water and addition of thiosulfate. Considerable quantities of reduced S compounds are found in leachates and retort waters and these are oxidized over time. Rates may be controlled by microbiological activity. These transformations influence chemistry and may also provide a biological treatment of retort water. (DMC)

60908 (DOE/EV/10298—4, pp IV.1-IV.27) **Environmental effects on the microbial mobilization of arsenic from retorted oil shale.** Klein, D.A. (Colorado State Univ., Fort Collins); Hassler, R.A.; Meglen, R.R.; Sistko, R. 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

These studies were carried out to provide information on the possible effects of environmental variables on the movement of soluble and volatile forms of arsenic from retorted shale. The objectives are: to determine the ability of microorganisms to mobilize arsenic (As) from spent shales and the factors affecting rates of microbial mobilization. Microorganisms can volatilize a significant fraction of As present in or added to spent shale. Significant volatilization does not occur without added nutrients and the amounts depend on retorting parameters, and to a lesser extent, the forms of As present or O_2 availability. Immobilization by adsorption may be a short-term process with partial re-release. Previous studies have shown high As concentrations in spent shale and wastewaters, but not in leachates and plants. If microbial activity can resolubilize or volatilize As, this may present a hazard to waters and/or the occupational environment.

60909 (DOE/EV/10298—4, pp V.A1-V.A26) **Geochemical baseline studies in the Uinta Basin, Utah and plant uptake of trace elements at the CSU intensive study site.** Klusman, R.W.; Rice, J.A.; Brown, D.G. (Colorado School of Mines, Golden). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

The objectives of this study are to define the present pattern of trace element distribution in the Uinta Basin in Utah and collect and analyze plants from the Intensive Study site for trace element uptake. The study of trace element concentrations in stream sediments and plants from the Eastern Uinta Basin, Utah, has been completed. Plant data were similar to Colorado oil shale area, but with wider variation. Mo and Cu plant data indicate a potential molybdenosis area in Northern part of basin. Significant Mo uptake was found in Utah Sweetvetch and Fourwing Saltbush in intensive study site. Grasses show a strong year-to-year trend of increasing Mo. Mo concentration is related to depth of soil cover and fertilization treatment. Some evidence of elevated F levels were found. Geochemical baseline data can be explained in terms of geology and climate, and provide a basis for detecting anthropogenic influences. Mo and Cu values in some plants on soil over spent shale could cause Mo toxicity. (DMC)

60910 (DOE/EV/10298—4, pp V.B1-V.B26) **Concentration of chemical elements in plants growing on retorted oil shales.** Klusman, R.W.; Rice, J.A. (Colorado School of Mines, Golden). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

The objectives of the study are to continue the evaluation of trace element uptake of selected plant species on the revegetation panels at the Intensive Study Site in the Piceance Creek Basin, Colorado. The 1981 collection represents the third year of collection and should allow the beginnings of the discernment of compositional trends as plant roots begin to penetrate spent shale below the soil cover. In addition to the collections on the revegetation panels, native plant samples of the same species were collected outside the fence in order to tie the revegetation panel compositions to the baseline composition of the region. Soil samples were also collected at these sites. Soils and Indian ricegrass, Sherman's big bluestem, Utah sweetvetch, winterfat, fourwing saltbush, and western wheat grass were analyzed for the following: calcium, magnesium, potassium, copper, zinc, aluminium, boron, fluorine, molybdenum and copper. (DMC)

60911 (DOE/EV/10298—4, pp VI.1-VI.14) **Boron toxicity in range plants grown on retorted oil shale.** Smith, P.J.; Lindsay, W.L. (Colorado State Univ., Fort Collins). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

The objective of this study is to determine the effect of high boron (B) concentrations on dry matter production in native and introduced plants; B toxicity experiments using five range plants (Alkali sacaton, Fourwing saltbush, Lewis flax, Tall wheatgrass, and Western wheatgrass) showed decrease in dry matter yield only in Lewis flax at B levels corresponding to those observed (100 to 200 ppM) in plants growing on soil over spent shale. Also observed were high Mo and low Cu/Mo ratios in all but Lewis flax; and very high B levels (100 to 200 ppM) have been observed in some plants in revegetation plots. These experiments indicate that for some, perhaps most range species, B toxicity may not be a problem. However, there are consistent observations of high Mo (greater than 15 ppM) and low Cu/Mo ratios (less than 2) that could cause Mo toxicity in grazing animals.

60912 (DOE/EV/10298—4, pp IX.1-IX.18) **Mathematical modeling, control and transport mechanisms of soluble pollutants from spent oil shales.** Ramirez, W.F. (Univ. of Colorado, Boulder). 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

The objective of this program is to characterize the porous media properties and basic release mechanisms of spent shale necessary to determine and predict the transport of leachates through surface piles or MIS retorts. A number of porous media properties have now been measured. These include: pore size distributions, specific surface areas, porosity, permeability, dispersion and capacitance effects. These data have suggested a transport phenomena model which is now being applied to test its validity. The model consists of main channel flow regions coupled to a dead space volume with terms describing convection, dispersion, and kinetic generation. The data also indicate that surface chemistry plays an important role in leaching phenomena. The studies done to date and the ability to fit a model give the capability for defining basic underlying mechanisms such as desorption and solubility limits. This ability will allow generalization from one process to another, an understanding of fundamental controlling mechanisms and variables, and development of data needed for PNL UNSAT model.

05 NUCLEAR FUELS

0501 Reserves

REFER ALSO TO CITATION(S) 62561

60913 **(GJO—100-82) Statistical data of the uranium industry.** (Department of Energy, Grand Junction, CO (USA). Grand Junction Office). 1 Jan 1982. 85p. NTIS, PC A05/MF A01. Order Number DE82021651.

Statistical Data of the Uranium Industry is a compendium of information relating to US uranium reserves and potential resources and to exploration, mining, milling, and other activities of the uranium industry through 1981. The statistics are based primarily on data provided voluntarily by the uranium exploration, mining, and milling companies. The compendium has been published annually since 1968 and reflects the basic programs of the Grand Junction Area Office (GJAO) of the US Department of Energy. The production, reserves, and drilling information is reported in a manner which avoids disclosure of proprietary information.

0502 Exploration

60914 **(DOE/NBM—2021060) Radioactive occurrences in veins and igneous and metamorphic rocks of New Mexico with annotated bibliography.** McLemore, V.T. (New Mexico Bureau of Mines and Mineral Resources, Socorro (USA)). 1982. 313p. (OFR—155-NM). NTIS, PC A14/MF A01. Order Number DE82021060.

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From an extensive literature search and field examination of 96 nonsandstone radioactive occurrences, the author compiled an annotated bibliography of over 600 citations and a list of 327 radioactive occurrences in veins and igneous and metamorphic rocks of New Mexico. The citations are indexed by individual radioactive occurrence, geographic area, county, fluorspar deposits and occurrences, geochemical analyses, and geologic maps. In addition, the geology, mineralization, and uranium and thorium potential of 41 geographic areas in New Mexico containing known radioactive occurrences in veins and igneous and metamorphic rocks or that contain host rocks considered favorable for uranium or thorium mineralization are summarized. A list of aerial-radiometric, magnetic, hydrogeochemical, and stream-sediment survey reports is included.

60915 **(E—82-10028) Integration of LANDSAT with geology and airborne geophysics into an operational mineral exploration system. Final report, June 1978 - December 1980.** Lyon, R.J.P.; Crawford, M.F. (Stanford Univ., CA (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Mar 1981. 270p. NTIS, PC A12/MF A01.

Digital data, gamma-ray spectrometry and aeromagnetic data were digitally combined and analyzed for the Bearlodge area (northeastern Wyoming) where potential resources of thorium and rare earths occur. The combined LANDSAT-geophysical data set revealed several geologic structures that were not evident in a single data set for the study area. Both qualitative and quantitative methods of analysis were performed on the combined data sets. Qualitative analysis of the data was done on a computer controlled, interactive color TV display system by overlaying the various data sets in different colors. In the Bearlodge area, this analysis revealed a pair of northwest-southeast tranding lineaments in the LANDSAT image which appeared to truncate a zone of high radioactivity. An elliptical feature formed by drainages is found. An intense thorium-gamma ray anomaly which coincides with thorium-rare earth mineralization, occurs inside this elliptical feature.

60916 **(GJBX—15-82) Uranium hydrogeochemical and stream-sediment reconnaissance of the Wallace NTMS Quadrangle, Idaho/Montana. National Uranium Resource Evaluation.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Los Alamos National Lab., NM (USA)). Jun 1982. Contract AC13-76GJ01664;W-7405-ENG-36. 217p. NTIS (US Sales Only). Order Number DE82020452.

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This report presents results of a Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of the Wallace NTMS quadrangle, Idaho/Montana. In addition to this abbreviated data release, more complete data are available to the public in machine-readable form. These machine-readable data, as well as quarterly or semiannual program progress reports containing further information on the HSSR program in general, or on the Los Alamos National Laboratory (LANL) portion of the program in particular, are available from DOE's Technical Library at its Grand Junction Area Office. Presented in this data release are location data, field analyses, and laboratory analyses of several different sample media. For the sake of brevity, many field site observations have not been included in this volume; these data are, however, available on the magnetic tape. Appendices A through C describe the sample media and summarize the analytical results for each medium. The data have been subdivided by one of the Los Alamos National Laboratory sorting programs of Zinkl and others (1981a) into groups of stream-sediment, stream-water, and ground-water samples. For each group which contains a sufficient number of observations, statistical tables, tables of raw data, and 1:1,000,000 scale maps of pertinent elements have been included in this report. Also included are maps showing results of multivariate statistical analyses. Information on the field and analytical procedures used by the Los Alamos National Laboratory during sample collection and analysis may be found in any HSSR data release prepared by the Laboratory and will not be included in this report.

60917 **(GJBX—68-82) Hydrogeochemical and stream sediment reconnaissance basic data for Tyler, Shreveport, and Jackson Quadrangles, Texas, Louisiana, Mississippi.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Oak Ridge National Lab., TN (USA)). 26 May 1982. Contract AC13-76GJ01664;W-7405-ENG-26. 21p. (K/UR—423). NTIS (US Sales Only). Order Number DE82021682.

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Hydrogeochemical data are compiled for stream-sediment reconnaissance of Tyler, Shreveport and Jackson quadrangles in Texas, Louisiana, and Mississippi. (ATT)

60918 **(GJBX—71-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Oklahoma City, Fort Smith, and Russellville Quadrangles, Oklahoma, Arkansas.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Oak Ridge National Lab., TN (USA)). 9 Jun 1982. Contract AC13-76GJ01664;W-7405-ENG-26. 26p. (K/UR—426). NTIS (US Sales Only). Order Number DE82020434.

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Hydrogeochemical data are compiled for the stream-sediment reconnaissance of Oklahoma City, Fort Smith and Russellville quadrangles in Oklahoma and Arkansas. (ATT)

60919 **(GJBX—72-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Enid, Tulsa, and Harrison Quadrangles, Oklahoma, Arkansas, Missouri.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Oak Ridge National Lab., TN (USA)). 9 Jun 1982. Contract AC13-76GJ01664;W-7405-ENG-26. 81p. (K/UR—427). NTIS (US Sales Only). Order Number DE82020433.

Portions of document are illegible.

Hydrogeochemical data are compiled for the stream-sediment reconnaissance of Enid, Tulsa, and Harrison quadrangles in Oklahoma, Arkansas, and Missouri. (ATT)

60920 **(GJBX—73-82) Hydrogeochemical and stream sediment reconnaissance basic data for Joplin, Springfield and Rolla Quadrangles, Missouri; Kansas; Illinois.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 25 May 1982. Contract AC13-76GJ01664. 46p. (K/UR—428). NTIS (US Sales Only). Order Number DE82021681.

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Hydrogeological data are compiled for stream-sediment reconnaissance of Joplin, Springfield and Rolla Quadrangles in Missouri, Kansas, and Illinois. (ATT)

60921 **(GJBX—74-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Columbia, Chattanooga, Gadsden, and Rome Quadrangles, Tennessee; Alabama; Georgia.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 25 May 1982. Contract AC13-76GJ01664. 26p. (K/UR—429). NTIS (US Sales Only). Order Number DE82021680.

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Hydrogeochemical data are compiled for stream-sediment reconnaissance of Columbia, Chattanooga, Gadsden, and Rome Quadrangles in Tennessee, Alabama and Georgia. (ATT)

60922 **(GJBX—75-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Nashville, Corbin, and Johnson City Quadrangles, Tennessee, Kentucky, Virginia, North Carolina.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Oak Ridge National Lab., TN (USA)). 7 Jun 1982. Contract AC13-76GJ01664;W-7405-ENG-26. 41p. (K/UR—430). NTIS (US Sales Only). Order Number DE82020432.

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Hydrogeochemical data are compiled for the stream-sediment reconnaissance of Kentucky, Virginia, North Carolina, and of Nashville, Corbin, Johnson City quadrangles in Tennessee. (ATT)

60923 **(GJBX—76-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Paducah and Evansville Quadrangles, Kentucky; Illinois; Indiana; Missouri.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 25 May 1982. Contract AC13-76GJ01664. 100p. (K/UR—431). NTIS (US Sales Only). Order Number DE82021679.

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Hydrogeochemical data are compiled for stream-sediment reconnaissance of Kentucky, Illinois, Indiana, and Missouri. (ATT)

60924 **(GJBX—77-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Winchester Quadrangle, Kentucky.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1 Jun 1982. Contract AC13-76GJ01664. 121p. (K/UR—432). NTIS (US Sales Only). Order Number DE82021678.

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Hydrogeochemical data are compiled for stream-sediment reconnaissance of Winchester Quadrangle in Kentucky. (ATT)

60925 **(GJBX—79-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Columbus and Clarksburg Quadrangles, Ohio; West Virginia; Pennsylvania.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 28 May 1982. Contract AC13-76GJ01664. 21p. (K/UR—434). NTIS (US Sales Only). Order Number DE82021676.

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Hydrogeochemical data are compiled for stream-sediment reconnaissance of West Virginia, Pennsylvania, and Ohio. (ATT)

60926 **(GJBX—81-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Wilmington and Salisbury Quadrangles, Maryland; Delaware; Pennsylvania; New Jersey.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 28 May 1982. Contract AC13-76GJ01664. 6p. (K/UR—436). NTIS (US Sales Only). Order Number DE82021675.

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Hydrogeochemical data are compiled for stream-sediment reconnaissance of Delaware, Maryland, Pennsylvania and New Jersey. (ATT)

60927 **(GJBX—82-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Scranton Quadrangle, New York; Pennsylvania; New Jersey.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 25 May 1982. Contract AC13-76GJ01664. 31p. (K/UR—437). NTIS (US Sales Only). Order Number DE82021674.

Portions of document are illegible.

Hydrogeochemical data are compiled for stream-sediment reconnaissance of Pennsylvania, New Jersey, and New York. (ATT)

60928 **(GJBX—83-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Elmira, Binghamton, and Albany Quadrangles, New York; Massachusetts; Vermont; New Hampshire. National Uranium Resource Evaluation Project.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 26 May 1982. Contract AC13-76GJ01664. 75p. (K/UR—438). NTIS (US Sales Only). Order Number DE82021673.

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Hydrogeochemical data are compiled for the stream-sediment reconnaissance of Massachusetts, Vermont, New Hampshire and New York. (ATT)

60929 **(GJBX—84-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Rochester and Kingston Quadrangles, New York. National Uranium Resource Evaluation Project.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 28 May 1982. Contract AC13-76GJ01664. 31p. (K/UR—439). NTIS (US Sales Only). Order Number DE82021672.

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Hydrogeochemical data are compiled for the stream-sediment reconnaissance of Rochester and Kingston quadrangles in New York. (ATT)

60930 **(GJBX—86-82) Hydrogeochemical and stream-sediment reconnaissance basic data for Glens Falls Quadrangle, New York, Vermont, New Hampshire.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Oak Ridge National Lab., TN (USA)). 7 Jun 1982. Contract AC13-76GJ01664;W-7405-ENG-26. 31p. (K/UR—441). NTIS (US Sales Only). Order Number DE82020428.

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Hydrogeochemical data are compiled for the stream-sediment reconnaissance of Vermont, New Hampshire and of Glens Falls quadrangle in New York. (ATT)

60931 **(GJBX—108-82) Uranium hydrogeochemical and stream-sediment reconnaissance of the Tanana NTMS Quadrangle, Alaska. National Uranium Resource Evaluation.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Los Alamos National Lab., NM (USA)). Apr 1982. Contract AC13-76GJ01664. 74p. NTIS (US Sales Only). Order Number DE82021671.

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This report presents results of a Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of the Tanana NTMS quadrangle, Alaska. In addition to this abbreviated data release, more complete data are available to the public in machine-readable form. These machine-readable data, as well as quarterly or semiannual program progress reports containing further information on the HSSR program in general, or on the Los Alamos National Laboratory (LANL) portion of the program in particular, are available from DOE's Technical Library at its Grand Junction Area Office. Presented in this data release are location data, field analyses, and laboratory analyses of several different sample media. For the sake of brevity, many field site observations have not been included in this volume; these data are, however, available on the magnetic tape. Appendix A describes the sample medium and summarizes the analytical results for that medium. The data have been subdivided by one of the Los Alamos National Laboratory sorting program of Zinkl and others (1981a) into groups of stream-sediment and lake-sediment samples. For each group which contains a sufficient number of observations, statistical tables, tables of raw data, and 1:1,000,000 scale maps of pertinent elements have been included in this report. Also included are maps showing results of multivariate statistical analyses. Information on the field and analytical procedures used by the Los Alamos National Laboratory during sample collection and analysis may be found in any HSSR data release prepared by the Laboratory and will be included in this report.

60932 **(GJBX—122-82) Uranium hydrogeochemical and stream-sediment reconnaissance of the Black River NTMS Quadrangle, Alaska. National Uranium Resource Evaluation.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Los Alamos National Lab., NM (USA)). Aug 1982. Contract AC13-76GJ01664. 93p. NTIS (US Sales Only). Order Number DE82021669.

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This report presents results of a Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of the Black River NTMS quadrangle, Alaska. In addition to this abbreviated data release, more complete data are available to the public in machine-readable form. These machine-readable data, as well as quarterly or semiannual program progress reports containing further information on the HSSR program in general, or on the Los Alamos National Laboratory (LANL) portion of the program in particular, are available from DOE's Technical Library at its Grand Junction Area Office. Presented in this data release are location data, field analyses, and laboratory analyses of several different sample media. For the sake of brevity, many field site observations have not been included in this volume; these data are, however, available on the magnetic tape. Appendices A and B describe the sample media and summarize the analytical results for each medium. The data have been subdivided by one of the Los Alamos National Laboratory sorting programs of Zinkl and others (1981a) into groups of stream-sediment and lake-sediment samples. For each group which contains a sufficient number of observations, statistical tables, tables of raw data, and 1:1,000,000 scale maps of pertinent elements have been included in this report. Also included are maps showing results of multivariate statistical analyses. Information on the field and analytical procedures used by the Los Alamos National Laboratory during sample collection and analysis may be found in any HSSR data release prepared by the Laboratory and will not be included in this report.

60933 **(GJBX—178-82) Uranium hydrogeochemical and stream-sediment reconnaissance of the Charley River NTMS Quadrangle, Alaska. National Uranium Resource Evaluation.** (Bendix Field Engineering Corp., Grand Junction, CO (USA); Los Alamos National Lab., NM (USA)). Aug 1982. Contract AC13-76GJ01664. 147p. NTIS (US Sales Only). Order Number DE82021668.

Portions of document are illegible.

This report presents results of a Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of the Charley River NTMS quadrangle, Alaska. In addition to this abbreviated data release, more complete data are available to the public in machine-readable form. These machine-readable data, as well as quarterly or semiannual program progress reports containing further information on the HSSR program in general, or on the Los Alamos National Laboratory (LANL) portion of the program in particular, are available from DOE's Technical Library at its Grand Junction Area Office. Presented in this data release are location data, field analyses, and laboratory analyses of several different sample media. For the sake of brevity, many field site observations have not been included in this volume; these data are, however, available on the magnetic tape. Appendices A and B describe the sample media and summarize the analytical results for each medium. The data have been subdivided by one of the Los Alamos National Laboratory sorting programs of Zinkl and others (1981a) into groups of stream-sediment and lake-sediment ground-water samples. For each group which contains a sufficient number of observations, statistical tables, tables of raw data, and 1:1,000,000 scale maps of pertinent elements have been included in this report. Also included are maps showing results of multivariate statistical analyses. Information on the field and analytical procedures used by the Los Alamos National Laboratory during sample collection and analysis may be found in any HSSR data release prepared by the Laboratory and will not be included in this report.

60934 **(GJBX—204-82) Detailed geochemical study of the Dan River-Danville Triassic Basin, North Carolina and Virginia. National Uranium Resource Evaluation Program.** Thayer, P.A.; Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1982. Contract AC09-76SR00001. 321p. (DPST—81-141-11). NTIS PCE11/MF A01. Order Number DE82021064.

Includes 3 sheets of 48x reduction microfiche. Portions of document are illegible.

This abbreviated data report presents results of surface geochemical reconnaissance in the Dan River-Danville Triassic Basin of north-central North Carolina and south-central Virginia. Unweathered rock samples were collected at 380 sites within the basin at a nominal sampling density of one site per square mile. Field measurements and observations are reported for each site; analytical data and field measurements are presented in tables and maps. A detailed four-channel spectrometric survey was conducted, and the results are presented as a series of symbol plot maps for eU, eTh, and eU/eTh. Data from rock sample sites (on microfiche in pocket) include rock type and color and elemental analyses for U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Na, Sc, Sm, Ti, V, and Yb. Elemental uranium in 362 sedimentary rock samples from the Dan River-Danville Basin ranges from a low of 0.1 to a maximum of 13.3 parts per million (ppM). The log mean uranium concentration for these same samples is 0.37 ppM, and the log standard deviation is 0.24 ppM. Elemental uranium in 10 diabase dike samples from within the basin is in the range 0.1 to 0.7 ppM. The log mean uranium concentration for diabase samples is -.65 ppM, and the log standard deviation is 0.27. This report is issued in draft form, without detailed technical and copy editing. This was done to make the report available to the public before the end of the NURE program.

60935 **(GJBX—205-82) Evaluation of uranium geochemical anomalies in the Greenville, SC, area, Greenville 1° x 2° Quadrangle (Greenville and Greer). National Uranium Resource Evaluation Program.** Sargent, K.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1982. Contract AC09-76SR00001. 39p. (DPST—81-141-14). NTIS PCE01/MF A01. Order Number DE82021071.

Includes 2 sheets of 48x reduction microfiche. Portions of document are illegible.

The Savannah River Laboratory (SRL) was involved in the National Uranium Resource Evaluation (NURE) from 1974 through 1981. The SRL role was to design and conduct and report the data from a geochemical reconnaissance of almost half the continental United States. The purpose of the work was to provide a basis for evaluation of the uranium potential of areas and to identify areas meriting some conventional geologic followup. More than 275,000 samples of stream sediment, soil, vegetation, and ground or surface water were collected in the program. As part of the development program to support interpretation of the geochemical data, SRL conducted a series of field studies to verify anomalies identified in the reconnaissance data. Subcontractors were selected to conduct field scintillometer surveys, compile geologic maps, collect additional samples, or provide other services as needed for a given study. This report presents the results of a small study in the Greenville 1° x 2° quadrangle. The study was conducted for SRL by Kenneth A. Sargent. This study is one of a series designed to provide a basis for interpretation of SRL regional geochemical reconnaissance data. It contains the results of a four-channel gamma spectrometer survey of an area around Greenville, South Carolina. The report is issued in draft form, without detailed technical and copy editing. This was done to make the report available to the public before the end of the NURE program.

60936 **(GJBX—206-82) Orientation study of the Lake Sunapee area, New Hampshire. National Uranium Resource Evaluation Program.** Karfunkel, B.S.; Sargent, K.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1982. Contract AC09-76SR00001. 38p. (DPST—81-141-20). NTIS, PC A03/MF A01. Order Number DE82021070.

Portions of document are illegible.

An orientation study was conducted in the area of Lake Sunapee, New Hampshire, in preparation for a hydrogeochemical and stream sediment reconnaissance in glacial terrain. The study was carried out by the Savannah River Laboratory as part of the National Uranium Resource Evaluation (NURE). Ground water, lake water, stream water, lake sediment, and stream sediment samples were collected at 188 sites. The concentrations of uranium and other elements were determined by neutron activation analysis. This report is issued in draft form, without detailed technical and copy editing. This was done to make the report available to the public before the end of the NURE program.

60937 **(GJBX—207-82) Geochemical orientation survey of stream sediment, stream water, and ground water near uranium prospects, Monticello area, New York. National Uranium Resource Evaluation Program.** Rose, A.W.; Smith, A.T.; Wesolowski, D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1982. Contract AC09-76SR00001. 127p. (DPST—81-141-23). NTIS PCE06/MF A01. Order Number DE82021069.

Includes 1 sheet of 48x reduction microfiche. Portions of document are illegible.

A detailed geochemical test survey has been conducted in a 570 sq km area around six small copper-uranium prospects in sandstones of the Devonian Catskill Formation near Monticello in southern New York state. This report summarizes and interprets the data for about 500 stream sediment samples, 500 stream water samples, and 500 ground water samples, each analyzed for 40 to 50 elements. The groundwater samples furnish distinctive anomalies for uranium, helium, radon, and copper near the mineralized localities, but the samples must be segregated into aquifers in order to obtain continuous well-defined anomalies. Two zones of uranium-rich water (1 to 16 parts per billion) can be recognized on cross sections; the upper zone extends through the known occurrences. The anomalies in uranium and helium are strongest in the deeper parts of the aquifers and are diluted in samples from shallow wells. In stream water, copper and uranium are slightly anomalous, as in an ore factor derived from factor analysis. Ratios of copper, uranium, and zinc to conductivity improve the resolution of anomalies. In stream sediment, extractable uranium, copper, niobium, vanadium, and an ore factor furnish weak anomalies, and ratios of uranium and copper to zinc improve the definition of anomalies. The uranium/thorium ratio is not helpful. Published analyses of rock samples from the nearby stratigraphic section show distinct anomalies in the zone containing the copper-uranium occurrences. This report is being issued without the normal detailed technical and copy editing, to make the data available to the public before the end of the National Uranium Reconnaissance Evaluation program.

60938 **(GJBX—208-82) Hydrogeochemical and stream-sediment reconnaissance, orientation study, Ouachita Mountain area, Arkansas. National Uranium Resource Evaluation Program.** Steele, K.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1982. Contract AC09-76SR00001. 38p. (DPST—81-141-26). NTIS, PC A03/MF A01. Order Number DE82021068.

Portions of document are illegible.

A hydrogeochemical ground water orientation study was conducted in the multi-mineralized area of the Ouachita Mountains, Arkansas in order to evaluate the usefulness of ground water as a sampling medium for uranium exploration in similar areas. Ninety-three springs and nine wells were sampled in Clark, Garland, Hot Springs, Howard, Montgomery, Pike, Polk, and Sevier Counties. Manganese, barite, celestite, cinnabar, stibnite, copper, lead, and zinc are present. The following parameters were determined: pH, conductivity, alkalinity, U, Br, Cl, F, He, Mn, Na, V, Al, Dy, NO_3, NH_3, SO_4, and PO_4. The minerals appear to significantly affect the chemistry of the ground water. This report is issued in draft form, without detailed technical and copy editing. This was done to make the report available to the public before the end of the National Uranium Resource Evaluation.

60939 **(GJBX—209-82) Orientation study: Jasper and Hampton Counties, South Carolina. National Uranium Resource Evaluation Program.** Thayer, P.A.; Fay, W.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1982. Contract AC09-76SR00001. 47p. (DPST—81-141-29). NTIS, PC A03/MF A01. Order Number DE82021067.

This abbreviated data report presents results of a ground water and stream sediment orientation study in Jasper and Hampton Counties in southeastern South Carolina. Stream sediment samples were taken at 92 sites and sieved into four fractions for subsequent analysis. Surface water samples were taken at 68 of these sites. Ground water samples were collected at 108 sites. Neutron activation analysis results are given for uranium and nine other elements in ground water samples. Mass spectrometry results are given for helium in ground water samples. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data for sediment samples include (1) water chemistry measurements from sites where water was available (pH, conductivity, and alkalinity), and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Na, Sc, Sm, Ti, V, and Yb). Sample site descriptors such as stream characteristics and vegetation are also tabulated. Data for ground water samples include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements, where applicable (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Br, Cl, Dy, F, Mg, Mn, Na, and V). Helium analyses are given for ground water samples. Key data for surface water samples include (1) water quality measurements (pH, conductivity, and alkalinity) and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). The report is issued in draft form, without detailed technical and copy editing. This was done to make the report available to the public before the end of the National Uranium Resource Evaluation. 2 figures, 9 tables.

60940 **(PGJ/F—043-82) National Uranium Resource Evaluation: Cody Quadrangle, Wyoming.** Garrand, L.J.; Kopp, R.S.; Cohenour, R.E. (Garrand Corp., Salt Lake City, UT (USA)). Aug 1982. Contract AC13-76GJ01664. 189p. NTIS PCE08/MF $4.20. Order Number DE82021860.

Includes 6 sheets of 24x reduction microfiche. Portions of document are illegible.

The uranium resources of the Cody Quadrangle, Wyoming, were evaluated to a depth of 1500 m (5000 ft) using extensive surface and subsurface geologic information. Uranium occurrences that were reported in the literature, in reports of the US Atomic

Energy Commission, and by people in the area were located, described in detail, and sampled. Areas favorable for deposits of uranium are delineated by analysis of surface and aerial radiometric data, by geochemical data from rock and stream-sediment samples, by interpretation of lithofacies patterns and structure derived from lithologic and electric well log data, and by analysis of gamma-ray well log data. Five surface and subsurface favorable areas encompassing parts of three geologic units are delineated in the quadrangle. One of the areas is on the southern flank of the Pryor Mountains in the northeast corner of the quadrangle. There, the Madison Limestone contains a paleokarst topography, which provided favorable sites for the deposition of uranium ores. Three of the areas contain uranium deposits in sandstones (locally with conglomerates) of the Upper Morrison and Lower Cloverly Formations. These are channel-controlled peneconcordant deposits. Two of the sandstone deposits are in the northeast corner of the quadrangle, and one is southwest of Cody along the South Fork of the Shoshone River. One area located northwest of Cody, on the southern flank of the Beartooth Mountains, has anomalous radioactivity in shear zones, along small faults, and associated with jointed portions of the Flathead Sandstone. The anomalies occur about 50 ft above the unconformity with the Precambrian basement rocks. Fourteen geologic environments involving 35 geologic units are considered unfavorable for the deposition of uranium.

60941 **(PGJ/F—088(82)) National Uranium Resource Evaluation: Hutchinson Quadrangle, Kansas.** Fair, C.L.; Smit, D.E.; Gundersen, J.N. (Wichita State Univ., KS (USA)). Aug 1982. Contract AC13-76GJ01664. 102p. NTIS PCE05/MF A01. Order Number DE82020960.

Includes 1 sheet of 24x reduction microfiche. Portions of document are illegible.

Surface reconnaissance and detailed subsurface studies were done within the Hutchinson Quadrangle, Kansas, to evaluate uranium favorability in accordance with National Uranium Resource Evaluation criteria. These studies were designed in part to follow up prior airborne radiometric, hydrogeochemical, and stream-sediment surveys. Over 4305 well records were examined in the subsurface phase of this study. The results of these investigations indicate environments favorable for channel-controlled peneconcordant sandstone deposits in rocks of Cretaceous age and for Wyoming and Texas roll-type deposits in sandstones of Pennsylvanian age. The Cretaceous sandstone environments exhibit favorable characteristics such as a bottom unconformity; high bedload; braided, fluvial channels; large-scale cross-bedding; and an anomalous outcrop. The Pennsylvanian sandstone environments exhibit favorable characteristics such as arkosic cross-bedded sandstones, included pyrite and organic debris, interbedded shales, and gamma-ray log anomalies. Environments considered unfavorable for uranium deposits are limestone and dolomite environments, marine black shale environments, evaporative precipitate environments, and some fluvial sandstone environments. Environments considered unevaluated due to insufficient data include Precambrian plutonic, metamorphic, and sedimentary rocks, even though a large number of thin sections were available for study.

60942 **(PGJ/F—089-82) National Uranium Resource Evaluation: Sherman Quadrangle, Texas and Oklahoma.** Hobday, D.K.; Rose, F.G. Jr. (Texas Univ., Austin (USA). Bureau of Economic Geology). Aug 1982. Contract AC13-76GJ01664. 145p. NTIS PC E08/MF $8.60. Order Number DE82021858.

Includes 28 sheets of 24x reduction microfiche.

Uranium favorability of the Sherman Quadrangle, Texas and Oklahoma, was evaluated using National Uranium Resource Evaluation criteria. Surface and subsurface geologic studies were supplemented by aerial radiometric surveys and hydrogeochemical and stream-sediment reconnaissance studies. A total of 1537 rock, soil, and stream-sediment samples were analyzed for 30 elements. Environments favorable for sandstone-type uranium deposits are present in the Cretaceous Antlers and Woodbine Formations, Pennsylvanian arkoses, and the Permian Wichita-Albany Group. The Antlers Formation is locally radioactive; and rock, stream-sediment, and ground-water samples show uranium enrichment. Dip-oriented sand belts may contain subsurface uranium deposits. Arkosic wedges in the Pennsylvanian Strawn, Canyon, and Cisco Groups were partially derived from a favorable Wichita Mountain source, were highly permeable, and contained downdip reductants; gamma-ray logs showed some anomalies. The Permian Wichita-Albany Group contained small uranium occurrences. The Woodbine Formation had an excellent uranium source in updip volcaniclastic correlatives, good permeability, and organic precipitants; but there is little direct evidence of uranium occurrences. Environments considered unfavorable for uranium deposits are limestones and shales of Cambrian to Pennsylvanian age, Pennsylvanian sandstones derived from a Ouachita source, Lower Cretaceous shales, limestones, and sandstones, Upper Cretaceous marine strata, and sparse Cenozoic sediments. Unevaluated environments include Precambrian granites and metasediments of the buried Muenster Arch.

60943 **(PGJ/F—090-82) National Uranium Resource Evaluation: Lovelock Quadrangle, Nevada and California.** Berry, V.P.; Bradley, M.T.; Nagy, P.A. (Berge Exploration, Inc., Denver, CO (USA)). Aug 1982. Contract AC13-76GJ01664. 100p. NTIS PCE05/MF $4.20. Order Number DE82020957.

Includes 6 sheets of 24x reduction microfiche. Portions of document are illegible.

Uranium resources of the Lovelock Quadrangle, Nevada and California, were evaluated to a depth of 1500 m using available surface and subsurface geological information. Uranium occurrences reported in the literature and in reports of the Atomic Energy Commission were located, sampled, and described in detail. Areas of anomalous radioactivity, as interpreted from the aerial radiometric reconnaissance survey and from the hydrochemical and stream-sediment reconnaissance survey reports, were also investigated. A general reconnaissance of the geologic environments exposed in surface outcrops was carried out; and over 400 rock, sediment, and water geochemical analyses were made from the samples taken. Additionally, 119 rock samples were petrographically studied. A total of 21 occurrences were located, sampled, and described in detail. Six uranium occurrences, previously unreported in the literature, were located during hydrogeochemical and stream-sediment reconnaissance, aerial radiometric reconnaissance survey followup, or general outcrop reconnaissance. Nine areas of uranium favorability were delineated within the Lovelock Quadrangle. One area, which contains the basal units of the Hartford Hill Rhyolite, is favorable for hydroallogenic uranium deposits. Eight areas are favorable for uranium deposits in playa sediments. These playas are considered favorable for nonmarine carbonaceous sediment deposits and evaporative deposits. The total volume of rock in favorable areas of the Lovelock Quadrangle is estimated to be 190 km^3. The remaining geologic units are considered to be unfavorable for uranium deposits. These include upper Paleozoic and Mesozoic volcanic, plutonic, sedimentary, and metamorphic rocks. Also unfavorable are Tertiary and Quaternary volcanic flows and intrusive phases, tuffs, and sediments.

60944 **(PGJ/F—091-82) National Uranium Resource Evaluation: Oklahoma City Quadrangle, Oklahoma.** Derby, J.R.; Upshaw, L.P.; Carter, E.O.; Roach, L.F.; Roach, D.G. (Geological Services of Tulsa, Inc., OK (USA)). Aug 1982. Contract AC13-76GJ01664. 89p. NTIS PCE03/MF A01. Order Number DE82019839.

Includes 2 sheets of 24x reduction microfiche. Portions of document are illegible.

Reconnaissance and detailed geologic and radiometric investigations were conducted throughout the Oklahoma City Quadrangle, Oklahoma, to evaluate the uranium favorability using National Uranium Resource Evaluation criteria. Surface and subsurface studies were augmented by data from aerial radiometric surveys, hydrogeochemical and stream-sediment reconnaissance studies, basement-rock computer modeling studies, and Track Etch surveys. The results indicate that there are no environments favorable for the occurrence of uranium deposits. Environments considered unfavorable for uranium deposits include beach placers, all sandstones at the surface, limestones, and evaporites. Some shallow subsurface sandstones in the vicinity of faulted oil fields may have important uranium deposits of the type found at Cement, Oklahoma (which is just outside the quadrangle limits). Subsurface phosphatic shales and marine black shales may also have uranium deposits. Environments of these types are unevaluated because of their inaccessibility.

60945 **(PGJ/F—092-82) National Uranium Resource Evaluation: Joplin Quadrangle, Missouri and Kansas.** Derby, J.R.; Upshaw, L.P.; Carter, E.O.; Roach, L.F.; Roach, D.G. (Geological Services of Tulsa, Inc., OK (USA)). Aug 1982. Contract AC13-76GJ01664. 213p. NTIS PCE08/MF A01. Order Number DE82020958.

Includes 4 sheets of 24x reduction microfiche. Portions of document are illegible.

Reconnaissance and detailed geologic and radiometric investigations were conducted throughout the Joplin Quadrangle, Missouri and Kansas, to evaluate the uranium favorability using National Uranium Resource Evaluation criteria. Surface and subsurface studies were augmented by aerial radiometric surveys and hydrogeochemical and stream-sediment reconnaissance studies. Results of the investigations indicate that black shales of Desmoinesian and Missourian (Pennsylvanian) age are environments favorable for the deposition of uranium. The uranium is concentrated in phosphate nodules within these black shales. Environments considered unfavorable for uranium deposits are fluvial placers, coals, limestones, all sandstones, peridotite, granites, the Pennsylvanian-Mississippian unconformity, and vein-type deposits in sedimentary rocks.

60946 **(PGJ/F—094-82) National Uranium Resource Evaluation: Wichita Falls Quadrangle, Texas and Oklahoma.** Edwards, M.B.; Andersen, R.L. (Texas Univ., Austin (USA). Bureau of Economic Geology). Aug 1982. Contract AC13-76GJ01664. 156p. NTIS PCE09/MF $8.40. Order Number DE82021859.

Includes 27 sheets of 24x reduction microfiche.

The uranium favorability of the Wichita Falls Quadrangle, Texas and Oklahoma, was determined by using National Uranium Resource Evaluation criteria; by subsurface studies of structure, facies distribution, and gamma-ray anomalies in well logs to a depth of 1500 m; and by surface studies involving extensive field sampling and radiometric surveying. These were supplemented by both aerial radiometric and hydrogeochemical and stream-sediment reconnaissance studies. Favorable environments were identified in fluviodeltaic to fan-delta sandstones in the upper Strawn, Canyon, and Cisco Groups (Pennsylvania to Lower Permian), which occur exclusively in the subsurface. Evaluation was based on the presence of a good uranium source, abundant feldspar, good hydrogeologic characteristics, association with carbonaceous shales, presence of coal and oil fields, and anomalies in gamma logs. Additional favorable environments include deltaic to alluvial sandstones in the Wichita-Albany Group (Lower Permian), which crops out widely and occurs in the shallow subsurface. Evaluation was based on high uranium values in stream-sediment samples, a small uranium occurrence located during the field survey, anomalous gamma logs, good uranium source, and hydrogeologic characteristics. Unfavorable environments include Cambrian to Permian limestones and shales. Pennsylvanian to Permian fluviodeltaic systems that have poor uranium sources, and Permian, Cretaceous, and Pleistocene formations that lack features characteristic of known uranium occurrences.

60947 **(PGJ/F—098-82) National Uranium Resource Evaluation: Wichita Quadrangle, Kansas.** Fair, C.L.; Smit, D.E.; Gundersen, J.N. (Wichita State Univ., KS (USA)). Aug 1982. Contract AC13-76GJ01664. 89p. NTIS PCE04/MF A01. Order Number DE82020587.

Includes 1 sheet of 24x reduction microfiche.

Surface reconnaissance and detailed subsurface studies were done within the Wichita Quadrangle, Kansas, to evaluate uranium favorability using National Uranium Resource Evaluation criteria. These studies were designed in part to follow up previous airborne radiometric, hydrogeochemical, and stream-sediment surveys. More than 7500 well records were examined in the subsurface phase of this study. Results of these investigations indicate environments favorable for Texas roll-type uranium deposits in sandstones of Pennsylvanian age within the Wichita Quadrangle. The Pennsylvanian environments exhibit favorable characteristics, such as arkosic cross-bedded sandstones, included pyrite and organic debris, interbedded shales, and gamma-ray log anomalies. Environments considered unfavorable for uranium deposits are limestone and dolomite environments, marine black shale environments, evaporative precipitate environments, and some fluvial sandstone environments. Environments considered unevaluated because of insufficient data (although some thin sections were available for study) include Precambrian plutonic, metamorphic, and sedimentary rocks.

60948 **(PGJ/F—101-82) National Uranium Resource Evaluation: Providence Quadrangle, Connecticut, Rhode Island, and Massachusetts.** Zollinger, R.C.; Blauvelt, R.P.; Chew, R.T. III. (Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). Sep 1982. Contract AC13-76GJ01664. 123p. NTIS PCE05/MF $4.20. Order Number DE82021650.

Includes 6 sheets of 24x reduction microfiche.

The Providence Quadrangle, Connecticut, Rhode Island, and Massachusetts, was evaluated to a depth of 1500 m to identify environments and delineate areas favorable for uranium deposits. Criteria for this evaluation were developed by the National Uranium Resource Evaluation program. Environments were recognized after literature research, surface and subsurface geologic reconnaissance, and examination of known uranium occurrences and aeroradioactivity anomalies. Environments favorable for authigenic uranium deposits were found in the Quincy and Cowesett Granites. An environment favorable for contact-metasomatic deposits is in and around the borders of the Narragansett Pier Granite where it intrudes the Pennsylvanian sediments of the Narragansett Basin. An environment favorable for authigenic deposits in metamorphic rocks is in a migmatite on the eastern edge of the Scituate Granite Gneiss batholith. Environments favorable for contact-metasomatic deposits occur at the contacts between many of the granitic rocks and metamorphic rocks of the Blackstone Series. Results of this study also indicate environments favorable for sandstone-type uranium deposits are present in the rocks of the Narragansett Basin. Environments unfavorable for uranium deposits in the quadrangle include all granites not classified as favorable and the metamorphic rocks of eastern Connecticut. Glacial deposits and Cretaceous-Tertiary sediments remain unevaluated.

60949 **(PGJ/F—105-82) National Uranium Resource Evaluation: Palestine Quadrangle, Texas and Louisiana.** McGowen, M.; Basciano, J.; Fose, F.G. Jr.; Fisher, W.L. (Texas Univ., Austin (USA). Bureau of Economic Geology). Sep 1982. Contract AC13-76GJ01664. 156p. NTIS PCE09/MF $8.40. Order Number DE82021656.

Includes 27 sheets of 24x reduction microfiche. Portions of document are illegible.

The uranium resource potential of the Palestine Quadrangle, Texas and Louisiana, was evaluated to a depth of 1500 m (5000 ft) using criteria established for the National Uranium Resource Evaluation program. Data derived from geochemical analyses of surface samples (substrate, soil, and stream sediment) in conjunction with hydrochemical data from water wells were used to evaluate geologic environments as being favorable or unfavorable for the occurrence of uranium deposits. Two favorable environments have been identified in the Palestine Quadrangle: potential deposits of modified Texas roll-type in fluvial channels and associated facies within the Yegua Formation, and potential occurrences along mineralization fronts associated with the Elkhart Graben and Mount Enterprise fault system. Unfavorable environments include: Cretaceous shales and limestones, Tertiary fine-grained marine sequences, Tertiary sandstone units that exhibit favorable host-rock characteristics but fail to show significant syngenetic or epigenetic mineralization, and Quaternary sands and gravels. Unevaluated units include the Woodbine Group (Upper Cretaceous), Jackson Group (Tertiary), and Catahoula Formation (Tertiary). The subsurface interval of the Jackson Group and Catahoula Formation contains depositional facies that may represent favorable environments; however, the evaluation of these units is inconclusive because of the general lack of shallow subsurface control and core material. The Woodbine Group, restricted to the subsurface except for a small exposure over Palestine Dome, occurs above 1500 m (5000 ft) in the northwest quarter of the quadrangle. The unit exhibits favorable host-rock characteristics, but the paucity of gamma logs and cores, as well as the lack of hydrogeochemical and stream-sediment reconnaissance data, makes evaluation of the unit difficult.

60950 **(PGJ/F—111-82) National Uranium Resource Evaluation: Lewistown Quadrangle, Montana.** Culver, J.C. (Robinson (Charles S.) and Associates, Inc., Lakewood, CO (USA)). Sep 1982. Contract AC13-76GJ01664. 272p. NTIS PCE10/MF A01. Order Number DE82021652.

Includes 3 sheets of 24x reduction microfiche. Portions of document are illegible.

Uranium resources in the Lewistown Quadrangle, Montana, were evaluated to a depth of 1500 m (5000 ft). All existing geologic data were considered, including geologic surveys, literature, theses, radiometric surveys, oil- and water-well logs. Additional data were generated during the course of two field seasons, including the collection of more than 350 water, rock, crude oil and panned concentrate samples for analyses, sedimentary facies maps, structural geology and isopach maps, and field examination of reported areas of anomalous radioactivity. Three environments with potential for the occurrence of a minimum of 100 t of 0.01% U_3O_8 were delineated. The most favorable environment is located in the southeastern portion of the quadrangle; here, Tertiary felsic dikes intrude four potential sandstone host rocks in the Kootenai Formation and the Colorado Shale. Structural-chemical traps for allogenic uranium are provided by the juxtaposition of oil-bearing domes. A second potential environment is located in the Eagle Sandstone in the northwestern and western portions of the quadrangle; here, anomalous water samples were obtained downtip from oxidized outcrops that are structurally related to Tertiary intrusive rocks of the Bearpaw and Highwood Mountains. Lignitic lenses and carbonaceous sandstones deposited in a near-shore lagoonal and deltaic environment provide potential reductants for hexavalent uranium in this environment. A third environment, in the Judith River Formation, was selected as favorable on the basis of water-well and gamma-ray log anomalies and their structural relationship with the Bearpaw Mountains. Organic materials are present in the Judith River Formation as potential reductants. They were deposited in a near-shore fluvial and lagoonal system similar to the depositional environment of the Jackson Group of the Texas Gulf Coast.

0504 Feed Processing

REFER ALSO TO CITATION(S) 60913

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 61008, 61469

60951 **Status of the national program on the development of high-uranium density, reduced-enrichment plate-type fuels.** Stahl, D. (Argonne National Lab., IL). *Transactions of the American Nuclear Society, Supplement;* **32**: 30-31(1979). (CONF-790807—).

From Topical conference on reactor operating experience; Arlington, TX, USA (5 Aug 1979).

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 60988, 61020

60952 **(AECL—7074) AECL programs in advanced systems research.** Bartholomew, G.A.; Fraser, J.S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1981. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702471.

The AECL program in advanced systems research is directed in the long term to securing the option of obtaining fissile fuel by electronuclear breeding (accelerator breeder or fusion breeder) and to providing a basis from which AECL might move into stand alone fusion energy if warranted. In the short term the program is directed to reaping benefits from electronuclear technology. This report outlines the main activities and research facilities in both the long-term and short-term subprograms.

60953 **(DPSPU—82-30-4) Criticality safety of the ten-well insert for the pot dissolver.** Forstner, J.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). May 1982. Contract AC09-76SR00001. 14p. (CONF-820609—35). NTIS, PC A02/MF A01. Order Number DE82016268.

From American Nuclear Society annual meeting; Los Angeles, CA, USA (6 Jun 1982).

Portions of document are illegible.

Nuclear safety for most fuels dissolved at SRP is ensured by some form of insert with a favorable geometry in a pot dissolver. A ten-well insert was designed which would permit an adequate charge of highly enriched U-Al alloy fuels of the MTR type. It can handle cylindrical fuel bundles up to 5 in. dia. Dependence on administrative control is reduced. 10 figures. (DLC)

60954 **(ORNL/TM—8435) Consolidated fuel-reprocessing program. Progress report, April 1-June 30, 1982.** Burch, W.D. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 41p. NTIS, PC A03/MF A01. Order Number DE82021106.

Highlights of progress accomplished during the quarter ending June 30, 1982 are summarized. Discussion is presented under the headings: Process development; Laboratory R and D; Engineering research; Engineering systems; Integrated equipment test facility operation; Instrument development; and HTGR fuel reprocessing.

60955 **(RFP—3324) Chemistry research and development. Annual progress report, November 1, 1980-September 30, 1981.** Miner, F.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 11 Aug 1982. Contract AC04-76DP03533. 86p. NTIS, PC A05/MF A01. Order Number DE82021952.

Research is reported in the general areas of chemical research, process chemistry (support and development), and product integrity and surveillance. Specific areas include thermodynamic properties of Pu compounds, reactions in Pu-H-O systems, actinide separation processes, surfaces of metals, alloy preparation for radiochemical tracers, pyrochemical processes for Pu recovery, and the Pu Recovery Facility. (DLC)

60956 **Reprocessing in breeder fuel cycles.** Burch, W.D.; Groenier, W.S. (ORNL-U.S., Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **40**: 104-105(1982). (CONF-820420—).

From International ENS/ANS conference on nuclear energy with emphasis on fuel cycles; Brussels, Belgium (26 Apr 1982).

60957 **Coprocessing solvent extraction flowsheet studies for LWR and FBR fuels.** Collins, E.D.; Benker, D.E.; Bigelow, J.E.; Chattin, F.R.; King, L.J.; Lloyd, M.H.; Ross, R.G.; Savage, H.C.; Stacy, R.G. (ORNL-U.S., Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **40**: 120-121(1982). (CONF-820420—).

From International ENS/ANS conference on nuclear energy with emphasis on fuel cycles; Brussels, Belgium (26 Apr 1982).

60958 **LWR fuel reprocessing in the United States.** Buckham, J.A.; Summer, W.B. (AGNS-U.S., Barnwell, SC 29812). *Transactions of the American Nuclear Society;* **40**: 125-127(1982). (CONF-820420—).

From International ENS/ANS conference on nuclear energy with emphasis on fuel cycles; Brussels, Belgium (26 Apr 1982).

60959 **Head-end tritium removal, fuel dissolution, and the nature of insoluble material from irradiated fuel.** Campbell, D.O.; Goode, J.H.; Vaughen, V.C.A. (ORNL-U.S., Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **40**: 127-128(1982). (CONF-820420—).

From International ENS/ANS conference on nuclear energy with emphasis on fuel cycles; Brussels, Belgium (26 Apr 1982).

60960 **Precision measurement and shearing of fuel rods for destructive analysis.** Deeken, P.G.; Fagan, J.E.; Kay, F.F.; Levitz, N.M. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **39**: 973-974(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

60961 **Neutron sources in spent-fuel assemblies and their dependence on irradiation parameters.** Bosler, G.E.; Phillips, J.R. (LASL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **35**: 120-122(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

0509 Transport And Storage

REFER ALSO TO CITATION(S) 61011, 61015, 61738

60962 **(SAND—82-0819) Shock and vibration environments encountered during normal rail transportation of heavy cargo.** Magnuson, C.F. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 17p. (TTC—0298). NTIS, PC A02/MF A01. Order Number DE82022238.

This study was conducted to obtain vibration and superimposed shock data during normal rail shipment of heavy cargo. The data were obtained during a regularly scheduled rail shipment of a 45-tonne (50-ton) cargo which consisted of an empty spent-fuel container, its supporting structure, and associated hoisting devices. The shipment was made over rail lines which are operated by the Atchison, Topeka, and Santa Fe Railway Company between Denver, Colorado and Albuquerque, New Mexico. The instrumented rail car was equipped with 0.38-m (15-in.) hydraulic end-of-car coupling devices. The 99 percentile levels of vibration acceleration amplitudes and single degree-of-freedom superimposed shock response spectra for the longitudinal, transverse, and vertical axes are presented.

60963 **(SAND—82-1200) Transportation Technical Environmental Information Center index.** Davidson, C.A.; Foley, J.T. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1982. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01. Order Number DE82018329.

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In an effort to determine the environmental intensities to which energy materials in transit may be exposed, a Data Center of technical environmental information has been established by Sandia National Laboratories, Division 5523, for the DOE Office of Transportation Fuel Storage. This document is an index which can be used to request data of interest. Access to the information held is not limited to Sandia personnel.

60964 **Assessment of interim storage of spent high-burnup.** Johnson, A.B. Jr., Bailey, W.J. (PNL-U.S., Richland, WA 99352). *Transactions of the American Nuclear Society;* **40**: 150-152(1982). (CONF-820420—).

From International ENS/ANS conference on nuclear energy with emphasis on fuel cycles; Brussels, Belgium (26 Apr 1982).

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 60958, 60983

60965 **(NP—2906075) Wyoming uranium mining and milling. A wage and employment survey, 1982.** (Wyoming Dept. of Labor and Statistics, Cheyenne (USA)). Jun 1982. 31p. Wyoming Department of Labor and Statistics, Hathaway Building, Cheyenne, WY 82002.

The results of a wage and employment survey of Wyoming's mining industry are reported. Data were collected to: enumerate the number of workers in selected occupational categories; determine the average straight-line hourly wage in each occupational category; determine the number of workers covered by a collective bargaining agreement in each occupational category; and review the employer contributions to employee fringe benefits. (DMC)

0520 Waste Management

REFER ALSO TO CITATION(S) 60955, 61014, 61311, 61313, 61319, 61320, 61380, 61478, 61563, 61801, 61824, 61835, 61965, 62196

60966 **(AECL—7337) Reverse-osmosis plant to process CRNL low-level radioactive liquid wastes.** Bourns, W.T. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1981. 8p. (CONF-8106200—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82905978.

From 21. annual international conference on Canadian Nuclear Association and 2. annual conference on Canadian Nuclear Society; Ottawa, Canada (8 Jun 1981).

The Waste Treatment Centre being built at Chalk River Nuclear Laboratories (CRNL) contains a reverse osmosis (RO) section for processing 30,000 m^3/a of dilute radioactive waste. The design, based on experimental work outlined here, incorporates three types of RO modules. An ultrafiltration (UF) section removes all suspended solids from the feed which is then transferred to a spiral wound RO unit. The purified water from it is discharged, while the concentrate from both units is concentrated further in a tubular RO section. The final concentrate goes to another part of the plant for immobilization of the radioactive solids in bitumen.

60967 **(AECL—7338) Bituminization of reactor wastes: development, design, and demonstration.** Buckley, L.P.; Pettipas, W.H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1981. 6p. (CONF-8106200—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82905977.

From 21. annual international conference on Canadian Nuclear Association and 2. annual conference on Canadian Nuclear Society; Ottawa, Canada (8 Jun 1981).

Conversion of reactor wastes to a stable leach-resistant form suitable for disposal has been the objective of a waste management program underway at Chalk River. Incinerator ash, ion-exchange resin and concentrated aqueous waste will be immobilized in bitumen. The dry ash will be combined with molten bitumen in a horizontal mixer while the ion-exchange resin and the liquid slurry will be mixed with a bitumen emulsion in a wiped-film evaporator. Laboratory evaluation of the processes and a demonstration of the wiped-film evaporator at the Douglas Point Nuclear Generating Station have provided details for the design of a Waste Treatment Centre at Chalk River. When the processes become operational in 1982, 200 drums (210 L each) of immobilized waste are expected each year; half will result from solidifying liquid and resin slurries and half from immobilizing incinerator ash.

60968 **(AECL—7437) Radwaste incineration at CRNL.** Beamer, N.V. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1981. 7p. (CONF-8106200—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82905976.

From 21. annual international conference on Canadian Nuclear Association and 2. annual conference on Canadian Nuclear Society; Ottawa, Canada (8 Jun 1981).

A Waste Treatment Centre (WTC) is being constructed at CRNL to develop and demonstrate processes to convert reactor wastes to a form suitable for disposal. Combustible wastes can be reduced in volume to a stable ash by incineration. A prototype starved-air incinerator in the WTC is currently being commissioned on inactive waste. Overall performance to date is good. Satisfactory control of main process flows and temperatures has been achieved. Checking of system response to process failures has begun. So far, problems with a similar incinerator during initial operation at Ontario Hydro have not been encountered.

60969 **(AECL—7439) Strategy for the disposal of low- and intermediate-level radwastes in Canada.** Dixon, D.F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1981. 7p. (CONF-8106200—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82905975.

From 21. annual international conference on Canadian Nuclear Association and 2. annual conference on Canadian Nuclear Society; Ottawa, Canada (8 Jun 1981).

The intent of the strategy described is to optimize both safety and cost of disposal by classifying waste segments according to hazardous lifetime and to match these to two or more selected disposal concepts graded according to containment and isolation capabilities. The bulk of low- and intermediate-level radwastes arising in Canada are a relatively short-lived hazard requiring isolation for no more than a few hundred years. Burial of this segment at tens-of-metres in quaternary deposits has been proposed as a concept worth evaluating. It is expected that part of the low- and intermediate-level radwastes will be potentially hazardous for geological time periods. Once methods of isolation for long-lived fuel wastes have been identified, these could be utilized for wastes requiring isolation for longer than a few hundred years. Disposal in a hard-rock vault is being evaluated as a reference concept and costs are presented. It is proposed that waste classification may consider more than two categories to further reduce costs and to better accommodate the radiological character of wastes. The overall disposal strategy should be flexible enough to account for present waste management practices and anticipated future needs.

60970 **(AECL—7522) Conditioning CANDU reactor wastes for disposal.** Beamer, N.V.; Bourns, W.T.; Buckley, L.P.; Speranzini, R.A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1981. 21p. (CONF-811056—9). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82905979.

From Seminar on the management of radioactive waste from nuclear power plants; Karlsruhe, F.R. Germany (5 Oct 1981).

A Waste Treatment Centre (WTC) is being constructed at the Chalk River Nuclear Laboratories to develop and demonstrate processes to convert reactor wastes to a form suitable for disposal. The WTC contains a starved air incinerator for reducing the volume of combustible solid wastes, a reverse osmosis section for reducing the volume of liquid wastes and an immobilization section for incorporating the conditioned wastes in bitumen. The incinerator is currently being commissioned on inactive waste: approximately 16.5 Mg of waste packaged in polyethylene bags has been incinerated in 17 burns. Average weight and volume reductions of 8.4:1 and 32:1, respectively, have been achieved. Construction of the reverse osmosis section of the WTC is complete and inactive commissioning will begin in January 1982. The reverse osmosis section was designed to process 30,000 m^3/a of dilute radioactive waste. The incinerator ash and concentrated aqueous waste will be immobilized in bitumen using a horizontal mixer and wiped-film evaporator. In this report, results obtained during inactive commissioning of the incinerator are described along with recent results of laboratory programs directed at demonstrating the reverse osmosis and bituminization processes.

60971 **(BNL—31650) Current status of low-level-waste-segregation technology.** Clark, D.E.; Colombo, P.; Sailor, V.L. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 15p. (CONF-820424—33). NTIS, PC A02/MF A01. Order Number DE82020024.

From ANS topical meeting on treatment and handling of radioactive wastes; Richland, WA, USA (19 Apr 1982).

The adoption of improved waste segregation practices by waste generators and burial sites will result in the improved disposal of low-level wastes (LLW) in the future. Many of the problems connected with this disposal mode are directly attributable to or aggravated by the indiscriminate mixing of various waste types in burial trenches. Thus, subsidence effects, contact with ground fluids, movement of radioactivity in the vapor phase, migration of radionuclides due to the presence of chelating agents or products of biological degradation, deleterious chemical reactions, and other problems have occurred. Regulations are currently being promulgated which will require waste segregation to a high degree at LLW burial sites. The state-of-the-art of LLW segregation technology and current practices in the USA have been surveyed at representative facilities. Favorable experience has been reported at various sites following the application of segregation controls. This paper reports on the state-of-the-art survey and addresses current and projected LLW segregation practices and their relationship to other waste management activities.

60972 **(BNL—31651) Waste segregation.** Clark, D.E.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 16p. (CONF-821110—3). NTIS, PC A02/MF A01. Order Number DE82020032.

From 3. annual national low-level waste management program meeting; New Orleans, LA, USA (4 Nov 1982).

A scoping study has been undertaken to determine the state-of-the-art of waste segregation technology as applied to the management of low-level waste (LLW). Present-day waste segregation practices were surveyed through a review of the recent literature and by means of personal interviews with personnel at selected facilities. Among the nuclear establishments surveyed were Department of Energy (DOE) laboratories and plants, nuclear fuel cycle plants, public and private laboratories, institutions, industrial plants, and DOE and commercially operated shallow land burial sites. These survey data were used to analyze the relationship between waste segregation practices and waste treatment/disposal processes, to assess the developmental needs for improved segregation technology, and to evaluate the costs and benefits associated with the implementation of waste segregation controls. This task was planned for completion in FY 1981. It should be noted that LLW management practices are now undergoing rapid change such that the technology and requirements for waste segregation in the near future may differ significantly from those of the present day. 8 figures.

60973 **(BNL-NUREG—31826) Study of non-fuel cycle wastes.** Gause, E.P. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 7p. (CONF-820854—7). NTIS, PC A02/MF A01.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

The low-level radioactive waste generated by many non-fuel cycle industries and institutions is not as well characterized as that produced by nuclear power plants. To better understand the variety of non-fuel cycle waste products now being disposed of by commercial shallow land burial (SLB) and to assess specific packages in advance of the enactment of the proposed regulation, 10 CFR Part 61 (dated June 29, 1981), Licensing Requirements for Land Disposal of Radioactive Waste, the United States Nuclear Regulatory Commission (NRC) requested Brookhaven National Laboratory (BNL), under FIN A-3165, (in April 1981), to provide technical assistance in expanding the data base on the physical and chemical characteristics of these wastes. With the cooperation of two major corporations, this program enabled the NRC to examine the achievability of the proposed 10 CFR Part 61 criteria, prior to the enactment of the regulation.

60974 **(BNL-NUREG—31827) Low-level-waste-form criteria.** Barletta, R.E.; Davis, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 7p. (CONF-820854—9). NTIS, PC A02/MF A01.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

Efforts in five areas are reported: technical considerations for a high-integrity container for resin wastes; permissible radionuclide loadings for organic ion exchange resin wastes; technical factors affecting low-level waste form acceptance requirements of the proposed 10 CFR 61 and draft BTP; modeling of groundwater transport; and analysis of soils from low-level waste disposal sites (Barnwell, Hanford, and Sheffield). (DLC)

60975 **(BNL-NUREG—31833) Properties of radioactive wastes and waste containers.** Morcos, N.; Dayal, R. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 5p. (CONF-820854—8). NTIS, PC A02/MF A01.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

This program is sponsored by the Nuclear Regulatory Commission to address basic concerns in assessing the performance of solidified radwaste. Experiments were initiated to address these concerns. In particular, leachability of solidified radwastes and the physical stability of the ensuing waste forms were evaluated. In addition, leaching experiments designed to address the effects of alternating wet/dry cycles and of varying the length of these cycles on the leach behavior of waste forms were initiated.

60976 **(CONF-820854—11) Low-level-waste-treatment handbook.** Clinton, S.D.; Goeller, H.E.; Holladay, D.W.; Donaldson, T.L. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE82022339.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

The initial draft of the Low-Level Waste Treatment Handbook has been prepared and submitted to the DOE Low-Level Waste Management Program for review and comment. A revised draft is scheduled to be delivered to DOE Headquarters in December 1982. The Handbook is designed to be useful to all individuals and groups concerned with low-level wastes. It is one of several volumes that will ultimately comprise a Low-Level Waste Technology Handbook. The objective of the Low-Level Waste Treatment Handbook is to present an overview of current practices related to the segregation, classification, volume reduction, solidification, handling, packaging, and transportation of LLW for disposal in a shallow land burial facility. The Handbook is intended to serve as a guide to individuals interested in the treatment and handling of low-level radioactive waste. The Handbook will not explicitly tell the user how to design and operate LLW treatment facilities, but rather will identify (1) kinds of information required to evaluate the options, (2) methods that may be used to evaluate these options, and (3) limitations associated with the selection of the treatment options. The focus of the Handbook is providing guidance on how to do waste treatment for disposal by shallow land burial.

60977 **(CONF-820933—4) Hydrologic and geologic aspects of low-level radioactive-waste site management.** Cutshall, N.H.; Vaughan, N.D.; Haase, C.S.; Olsen, C.R.; Huff, D.D. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01. Order Number DE82022244.

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

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Hydrologic and geologic site characterization is a critical phase in development of shallow land-burial sites for low-level radioactive-waste disposal, especially in humid environments. Structural features such as folds, faults, and bedding and textural features such as formation permeability, porosity, and mineralogy all affect the water balance and water movement and, in turn, radionuclide migration. Where these features vary over short distance scales, detailed mapping is required in order to enable accurate model predictions of site performance and to provide the basis for proper design and planning of site-disposal operations.

60978 **(DOE/ID/12348—T1) Comprehensive low-level waste management plan for the state of Kentucky. First quarterly report for the period ending December 31, 1981.** Fish, B.R.; Gregorio, S.B. (Kentucky Dept. for Natural Resources and Environmental Protection, Frankfort (USA)). Apr 1982. Contract FG07-81ID12348. 14p. NTIS, PC A02/MF A01. Order Number DE82020738.

This document reports on the following tasks: setup of Kentucky LLRW management unit, participation in meetings, and communication with other KY agencies. (DLC)

60979 **(DOE/NBM—2021741) Toward a national policy for managing low-level radioactive waste: key issues and recommendations.** Duerksen, C.J.; Mantell, M.; Thompson, G.P. (Conservation Foundation, Washington, DC (USA)). Jun 1981. Contract AC07-76ID01570. 180p. NTIS, PC A09/MF A01. Order Number DE82021741.

The Conservation Foundation, a not-for-profit research and public education organization, asked individuals with diverse backgrounds and viewpoints to come together under Foundation leadership as a Dialogue Group on Low-Level Radioactive Waste Management. The group, including persons who represent waste generators, concerned citizens, state regulators, and environmentalists, met over an 18-month period to discuss issues crucial to the development of a national policy on low-level wastes. The Dialogue Group agreed that three principles, if accepted broadly, would form the basis of a sound national policy for managing low-level radioactive wastes: with proper implementation, technology exists to manage low-level waste safely; generators and their customers should pay disposal costs; and greater public involvement at all stages can improve the disposal system. These principles acted as polestars for the group as it worked toward a series of policy recommendations in four main areas: (1) cleaning up closed commercial sites; (2) remodeling a system for defining and classifying low-level radioactive waste; (3) siting new low-level waste disposal facilities; and (4) decommissioning, long-term care, and liability. This report presents an extensive discussion of these recommendations covering qualifications, limitations, and alternatives.

60980 **(DOE/NV/10250—3) Commercial-nuclear-waste research and development program. Quarterly report, April through June 1982.** Hakl, A.R. (Westinghouse Electric Corp., Mercury, NV (USA). Advanced Energy Systems Div.). Jul 1982. Contract AC08-82NV10250. 28p. NTIS, PC A03/MF A01. Order Number DE82021996.

The purpose of the Westinghouse Electric Corporation Advanced Energy Systems Division Nevada Operations is to provide trained operating crews and services to perform nuclear materials handling, packaging, data acquisition, and other related activities at the E-MAD facility, Nevada Test Site. This document is a report of activities during the past quarter to meet task objectives of the Nevada Nuclear Waste Storage Investigations FY-1982 Project Plan. Significant accomplishments were: the first canister gas samples were acquired for the Dry Storage Fuel Integrity Demonstration; initial summary histories were prepared for the 17 fuel assemblies that have been utilized in activities at the Nevada Test Site; optional plans and cost estimates were developed for E-MAD support in deactivation of the Spent Fuel Test-Climax; all contract Deliverables were completed and transmitted to DOE/NV; construction of enclosures for the E-MAD stack air monitor detectors was initiated; maintenance/upgrade/calibration of facility systems and equipment have continued.

60981 **(DOE/NV/10253—1) Safety assessment for Area 5 radioactive-waste-management site.** Hunter, P.H.; Card, D.H.; Horton, K. (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA); Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Sep 1982. Contract AC08-82NV10253;AC08-76NV00410. 175p. NTIS, PC A08/MF A01. Order Number DE82021354.

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The Area 5 Radioactive Waste Management Safety Assessment Document contains evaluations of site characteristics, facilities, and operating practices that contribute to the safe handling, storage, and disposal of low-level radioactive wastes at the Nevada Test Site. Physical geography, cultural factors, climate and meteorology, geology, hydrology (with emphasis on radionuclide migration), ecology, natural phenomena, and natural resources are discussed and determined to be suitable for effective containment of radionuclides. A separate section considers facilities and operating practices such as monitoring, storage/disposal criteria, site maintenance, equipment, and support. The section also considers the transportation and waste handling requirements supporting the new Greater Confinement Disposal Facility (GCDF), GCDF demonstration project, and other requirements for the safe handling, storage, and disposal of low-level radioactive wastes. Finally, the document provides an analysis of releases and an assessment of the near-term operational impacts and dose commitments to operating personnel and the general public from normal operations and anticipated accidental occurrences. The conclusion of this report is that the Area 5 Radioactive Waste Management Site is suitable for low-level radioactive waste handling, storage, and disposal. Also, the

new GCDF demonstration project will not affect the overall safety of the Area 5 Radioactive Waste Management Site.

60982 **(DOE/NWTS—33-3) NWTS program criteria for mined geologic disposal of nuclear waste: repository performance and development criteria. Public draft.** (Battelle Memorial Inst., Columbus, OH (USA). National Waste Terminal Storage Integration). Jul 1982. Contract AC06-76RL01830. 44p. NTIS, PC A03/MF A01. Order Number DE82021021.

This document, DOE/NWTS-33(3) is one of a series of documents to establish the National Waste Terminal Storage (NWTS) program criteria for mined geologic disposal of high-level radioactive waste. For both repository performance and repository development it delineates the criteria for design performance, radiological safety, mining safety, long-term containment and isolation, operations, and decommissioning. The US Department of Energy will use these criteria to guide the development of repositories to assist in achieving performance and will reevaluate their use when the US Nuclear Regulatory Commission issues radioactive waste repository rules.

60983 **(DOE/UMT—0211) Cost of radon-barrier systems for uranium mill tailings.** Baker, E.G.; Hartley, J.N. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1982. Contract AC06-76RL01830. 41p. (PNL—4408). NTIS, PC A03/MF A01. Order Number DE82022037.

This report deals specifically with the cost of three types of radon barrier systems, earthen covers, asphalt emulsion covers, and multilayer covers, which could meet standards proposed by the Environmental Protection Agency to stabilize uranium mill tailings located primarily in the western US. In addition, the report includes a sensitivity analysis of various factors which significantly effect the overall cost of the three systems. These analyses were based on a generic disposal site. Four different 3m thick earthen covers were tested and cost an average of $27/m^3. The least expensive earthen cover cost was about $21/m^3. The asphalt cover system (6 to 7 cm of asphalt topped with 0.6m of overburden) cost about $28/m^3. The four multilayer covers averaged $57/m^3, but materials handling problems encountered during the test inflated this cost above what was anticipated and significant cost reductions should be possible. The least expensive multilayer cover cost $43/m^3. Based on the results of the Grand Junction field test we estimated the cost of covering the tailings from three high priority sites, Durango, Shiprock, and Salt Lake City (Vitro). The cost of a 3m earthen cover ranged from $18 to 33/m^3 for the seven disposal sites (two or three at each location) studied. The cost of asphalt cover systems were $23 to 28/m^3 and the multilayer cover costs were between $31 to 36/m^3. The earthen cover costs are less than the Grand Junction field test cost primarily because cover material is available at or near most of the disposal sites selected. Earthen material was imported from 6 to 10 miles for the field test. Assuming more efficienct utilization of materials significantly reduced the cost of the multilayer covers.

60984 **(DP—82-157-1) Composite quarterly technical report: long-term high-level-waste technology, January-March 1982.** Cornman, W.R. (comp.). (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1982. Contract AC09-76SR00001. 72p. NTIS, PC A04/MF A01. Order Number DE83000531.

Progress is reported in the following areas: program management and support, waste preparation (solidification and precipitation), waste fixation (in glass, concrete, or tailored ceramics), and final handling. Leaching data are given. (DLC)

60985 **(DPSPU—77-11-24) Nuclear heat-load limits for above-grade storage of solid transuranium wastes.** Clontz, B.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jun 1978. Contract AC09-76SR00001. 22p. NTIS, PC A02/MF A01. Order Number DE82015844.

Portions of document are illegible.

Nuclear safety and heat load limits were established for above-grade storage of transuranium (TRU) wastes. Nuclear safety limits were obtained from a study by J.L. Forstner and are summarized. Heat load limits are based on temperature calculations for TRU waste drums stored in concrete containers (hats), and results are summarized. Waste already in storage is within these limits. The limiting factors for individual drum heat load limits were (1) avoidance of temperatures in excess of 190°F (decomposition temperature of anion resin) when anion resin is present in a concrete hat, and (2) avoidance of temperatures in excess of 450°F (ignition temperature of paper) at any point inside a waste drum. The limiting factor for concrete had heat load limits was avoidance of temperatures in excess of 265°F (melt point of high density polyethylene) at the drum liners. A temperature profile for drums and hats filled to recommended limits is shown. Equations and assumptions used were conservative.

60986 **(HEDL-TC—1502-Rev.1) Possible effects of UO_2 oxidation on light water reactor spent fuel performance in long-term geologic disposal.** Almassy, M.Y.; Woodley, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1982. Contract AC06-76FF02170. 30p. NTIS, PC A03/MF A01. Order Number DE82021028.

Disposal of spent nuclear fuel in a conventionally mined geologic formation is the nearest-term option for permanently isolating radionuclides from the biosphere. Because irradiated uranium dioxide (UO_2) fuel pellets retain 95 to 99% of the radionuclides generated during normal light water reactor operation, they may represent a significant barrier to radionuclide release. This document presents a technical assessment of published literature representing the current level of understanding of spent fuel characteristics and conditions that may degrade pellet integrity during a geologic disposal sequence. A significant deterioration mechanism is spent UO_2 oxidation with possible consequences identified as fission gas release, rod diameter increases, cladding breach extension, and release of solid fuel particles containing radionuclides. Areas requiring further study to support development of a comprehensive spent fuel performance prediction model are highlighted. A program and preliminary schedule to obtain the information needed to develop model correlations are also presented.

60987 **(HEDL-TC—1729) Safety analysis report for the Radioactive Acid Digestion Test Unit (RADTU). Supplement 1.** Davis, J.S.; Berglund, C.J. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1980. Contract AC06-76FF02170. 30p. NTIS, PC A03/MF A01. Order Number DE83000269.

The RADTU facility is being modified to achieve an increased processing rate. The principal modification involves replacing the tray digester with an annular vessel. Several changes in the off-gas system were also made to accommodate the resulting increased off-gas volume. Three other modifications have been planned for RADTU. A reserve tank has been added to hold the fractionator acid should it ever become necessary to empty that vessel. A centrifuge will be installed to test its effectiveness in increasing the solids content of the slurry going to the residue drying system. A continuous residue dryer is being investigated as a replacement for the existing batch pot system. The new RADTU configuration can be operated without undue risk to employees and the public. The facility has adequate safety provisions for the protection of both property and the environment.

60988 (IAEA-TECDOC—248, pp 85-92) **Considerations on the decontamination of a reprocessing plant.** Hild, W. (Societe Europeenne pour le Traitement Chimique des Combustibles Irradies (EUROCHEMIC), Mol (Belgium)). Jun 1981. NTIS (US Sales Only), PC A05/MF A01.

From Technical committee meeting on the procedures of operating nuclear power plants and handling of decontamination wastes; Mol, Belgium (23 Apr 1979).

Although fundamental differences prevail in the radiochemical and chemical nature of contaminations in a power reactor and a reprocessing plant, the fundamental approach towards decontamination follows essentially the same lines for both plants: the best decontamination is to avoid contamination; first measures against contamination should already start at the design stage of the plant, comprising for instance, care for smooth surfaces, avoid dead zones, limit welds as much as possible in down stream parts, foresee possibilities for internal and external water jets, provide appropriate surface coatings, etc...; select appropriate operation conditions to reduce formation of contaminating cruds; adopt your decontamina-

tion procedure to the needs of your facility with respect to: corrosion behaviour, dose commitments, operational safety and compatibility with the waste treatment facilities. Efficient decontamination procedures have been developed and applied in various reprocessing plants in different countries. Experience gained at Eurochemic can in this respect be considered as a valuable contribution that certainly can be of help for the operation of nuclear power reactors, too.

60989 **(LA-UR—82-2372) Los Alamos DP West Plutonium Facility decontamination project.** Garde, R.; Cox, E.J.; Valentine, A.M. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 14p. (CONF-821005—10). NTIS, PC A02/MF A01. Order Number DE82021879.

From DOE international decommissioning symposium; Seattle, WA, USA (10 Oct 1982).

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The DP West Plutonium Facility operated by the Los Alamos National Laboratory, Los Alamos, New Mexico, was decontaminated between April 1978 and April 1981. The facility was constructed in 1944 to 1945 to produce plutonium metal and fabricate parts for nuclear weapons. It was continually used as a plutonium processing and research facility until mid-1978. Decontamination operations included dismantling and removing gloveboxes and conveyor tunnels; removing process systems, utilities, and exhaust ducts; and decontaminating all remaining surfaces. This report describes glovebox and conveyor tunnel separations, decontamination techniques, health and safety considerations, waste management procedures, and costs of the operation.

60990 **(LA-UR—82-2532) Alternatives to shallow land burial.** Burton, B.W. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 14p. (CONF-820854—6). NTIS, PC A02/MF A01. Order Number DE82022019.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

During FY79 and FY80 the Los Alamos National Laboratory and its contractors performed a preliminary assessment of several alternatives to shallow land burial of low-level waste, including deeper burial, mined cavities, specially engineered storage buildings, well injection of liquid waste, and seabed disposal. Only deeper burial and mined cavities seem acceptable as near-term alternatives. A waste management program using a combination of disposal alternatives is recommended. Research needed to implement the deeper burial and mined cavity options is identified.

60991 **(LA-UR—82-2533) Technical support non-SLB(GCDF).** DePoorter, G.L.; Burton, B.W. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 15p. (CONF-820854—4). NTIS, PC A02/MF A01. Order Number DE82022018.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

The Los Alamos National Laboratory is providing technical support for the Greater Confinement Demonstration Facility (GCDF) at the Nevada Test Site. This technical support consists of computer modeling of the GCDF, design and emplacement of a Shallow Test Plot at NTS, and instrument testing at Los Alamos. Results to date on the computer modeling and the Shallow Test Plot are described.

60992 **(LA-UR—82-2534) Remedial action technology - arid.** Hakonson, T.E.; DePoorter, G.L.; Nyhan, J.W.; Perkins, B.A.; Lane, L.J. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 19p. (CONF-820854—5). NTIS, PC A02/MF A01. Order Number DE82022017.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

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A summary is presented of the low-level waste remedial action program at Los Alamos. The experimental design and progress is described for the experiments on second generation intrusion barriers, subsidence effects on SLB components, moisture cycling effects on chemical transport, and erosion control methodologies. The soil moisture data from the bio-intrusion and moisture cycling experiments both demonstrate the overwhelming importance of vegetation in minimizing infiltration of water through trench covers and backfill. Evaporation, as a water loss component in trench covers, is only effective in reducing soil moisture within 40 cm of the trench cover surface. Moisture infiltrating past the zone of evaporation in unvegetated or poorly vegetated trench covers is in storage and accumulates until drainage out of the soil profile occurs. Judicious selection of vegetation species for revegetating a low-level waste site may prevent infiltration of moisture into the trench and, when coupled with other design features (i.e. trench cover slope, tilling and seeding practice), may greatly reduce problems with erosion. Standard US Department of Agriculture erosion plots, when coupled with a state-of-the-art water balance and erosion model (CREAMS) promises to be highly useful in screening proposed remedial action cover designs for low-level waste sites. The erosion plot configuration allows for complete accounting of the water balance in a soil profile. This feature enables the user to optimize cover designs to minimize erosion and infiltration of water into the trench.

60993 **(LA-UR—82-2535) Shallow land burial technology development - arid.** DePoorter, G.L.; Abeele, W.V.; Burton, B.W.; Hakonson, T.E.; Perkins, B.A. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 28p. (CONF-820854—3). NTIS, PC A03/MF A01. Order Number DE82021802.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

The experimental results obtained during FY-1982 on biointrusion barrier testing, migration barrier testing, and ground and surface water management system testing are described. The results of the small lysimeter study on biointrusion barriers are presented and the larger scale experiments in progress are described. The results of the experiments to determine the migration potential for water under unsaturated conditions are described. Preliminary results on the wick system experiment are presented. A comparison of model calculations and experimental results on the water movement experiments is also presented.

60994 **(NP—2904673) Time to take control: the states and low-level radioactive waste.** Melson, G. (National Conference of State Legislatures, Denver, CO (USA)). Jun 1981. 6p. NTIS, PC A02/MF A01. Order Number DE82904673.

Discussed is the progress states have made in the challenge of regional cooperation in the management of low-level radioactive wastes. The immediate need for new disposal sites and a long-term need for additional sites to handle the steadily increasing amounts of low-level wastes are described. Success depends on states taking ownership of the problem. The states are acting under a federal law enacted last year which encourages the formation of interstate compacts for dealing with low-level wastes. By 1986, a disposal site can refuse to accept wastes from a state that is not part of an interstate compact. Problems confronted in the siting of disposal facilities are discussed. A state may opt for establishing its own facility or stop generating low-level wastes. (DMC)

60995 **(NVO—247) Summary and conclusions of the NNWSI area-to-location screening activity.** Sinnock, S.; Fernandez, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 198p. NTIS, PC A07/MF A01. Order Number DE82022540.

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A comprehensive system study has been performed to screen the Nevada Research and Development Area (NRDA) of the Nevada Test Site (NTS) and nearby areas for relatively favorable locations of about ten square miles for the permanent disposal of radioactive waste in a mined repository. The purpose of this screening is to use available information to identify such locations. The results of this screening will allow more informed decisions as to where future repository exploration can be concentrated to optimize the chances that the locations chosen for characterization will actually qualify as a licensed repository site. The screening was conducted in a manner compatible with the general repository siting strategy of the DOE National Waste Terminal Storage Program (NWTS). This report has four chapters. Chapter 1 provides

background information regarding the NNWSI screening activity and its relationship to the national program. Chapter 2 describes the systems method used for quantitative evaluation of various locations and rock types in the screening area. It includes definitions of specific screening parameters and descriptions of the mathematical equations for calculating ratings for various locations and host rocks. Chapter 3 presents selected results of the numerical analyses. It shows and describes maps of location ratings and lists of saturated and unsaturated host-rock ratings. Chapter 4 summarizes the results and presents conclusions about which locations and rock types are most favorable. Appendices A through C contain supporting information for the discussions in the text.

60996 **(ONWI—106) Geological evaluation of Gulf Coast salt domes: overall assessment of the Gulf Interior Region.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Law Engineering Testing Co., Atlanta, GA (USA)). Oct 1981. Contract AC06-76RL01830. 165p. NTIS, PC A08/MF A01. Order Number DE82015755.

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The three major phases in site characterization and selection are regional studies, area studies, and location studies. This report characterizes regional geologic aspects of the Gulf Coast salt dome basins. It includes general information from published sources on the regional geology; the tectonic, domal, and hydrologic stability; and a brief description the salt domes to be investigated. After a screening exercise, eight domes were chosen for further characterization: Keechi, Oakwood, and Palestine Domes in Texas; Vacherie and Rayburn's domes in North Louisiana; and Cypress Creek and Richton domes in Mississippi. A general description of each, maps of the location, property ownership, and surface geology, and a geologic cross section were presented for each dome.

60997 **(PNL—4029) Surface concrete decontamination equipment developed by Pacific Northwest Laboratory.** Halter, J.M.; Sullivan, R.G.; Bevan, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1982. Contract AC06-76RL01830. 47p. NTIS, PC A03/MF A01. Order Number DE82021122.

This report documents a project that the Pacific Northwest Laboratory conducted to identify and develop techniques for removing contaminated concrete surfaces. A major problem associated with nuclear facility decontamination and decommissioning is how to economically demolish and dispose of contaminated concrete. Removing only the contaminated portion of the concrete can substantially reduce costs. Evaluation of various methods for removing concrete surfaces shows that several techniques presently used require excessive manpower, time, and energy. Many times more material is removed than necessary, increasing the quantity of waste that must be handled under controlled conditions. These evaluations generated the basic criteria for developing a suitable concrete removal technique: provide a convenient method for cleaning surfaces (such as those contaminated by a small spill); reduce the contaminated waste volume that has to be placed into controlled storage; remove surfaces quickly; and minimize personal exposure to potentially harmful radiation or toxic materials. Removal to 1/4 to 1/2 in. of contaminated surface layer is sufficient for cleanup of most facilities. Two unique decontamination methods have been developed: the concrete spaller and the water cannon. The concrete spaller is the most efficient technique: it removes the concrete surface faster than the water cannons and at a lower cost (as little as $3.00/ft^2 of concrete surface). However, the .458 magnum water cannon may be well suited for small or hard-to-reach locations.

60998 **(PNL—4389) Effect of organic complexants on the mobility of nickel and cobalt in soils. Status report.** Swanson, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1982. Contract AC06-76RL01830. 45p. NTIS, PC A03/MF A01. Order Number DE83000400.

A study is being conducted of the effect of organic complexing agents on the behavior of low-level waste radionuclides in soil/groundwater systems. This report contains the results of recent work with Ni and Co, two elements that have radioactive isotopes that are important to low-level waste disposal. The complexants studied were EDTA, DTPA, oxalate, and citrate. Data were obtained from experiments using soils from both an arid site (Hanford, Washington) and a humid site (Savannah River, South Carolina). Some work with cobalt was done in the absence of air to allow the behavior of the lower oxidation state to be studied. Important variations were observed in both the rates at which equilibrium was approached (from both the precomplexed and the presorbed directions) and the equilibrium positions themselves. The oxalate and citrate complexes are weaker and dissociate more rapidly than the EDTA and DTPA complexes. Dissociation of the EDTA and DTPA complexes occurred much more rapidly in solutions contacting Savannah River soil than in solutions contacting Hanford soil. 20 figures, 6 tables.

60999 **(RFP—3282) Commercial and Defense nitrate wastes and processing alternatives.** Johnson, A.J.; Meile, L.J.; Jaskot, G.F. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 25 Aug 1982. Contract AC04-76DP03533. 20p. NTIS, PC A02/MF A01. Order Number DE83000027.

Nitric acid is extensively used at commercial and defense facilities engaged in nuclear fuel reprocessing and/or actinide recovery and purification. The high volume usage of nitric acid results in the generation of large amounts of nitrate wastes. Commercial facilities in the nuclear fuel cycle report that they are able to handle most of their nitrate waste under current discharge limits but could have problems if these limits are lowered. The defense nuclear facilities generate by far the greater amount of waste nitrates. A separation system now planned for HLW at SRP, will convert large volumes of stored waste into a concentrated volume of HLW and large volumes of LLW nitrates. No processing systems are now operating that will produce a desirable final waste form. Several methods have been identified that could be used to destroy or convert the nitrate compounds to a waste more amenable to conversion into an acceptable waste form for final disposal.

61000 **(RHO-BW-SA—190) Hydrochemical and isotopic content of basalt groundwaters beneath the Hanford Site, Washington.** Spane, F.A. Jr.; Graham, D.L.; Bryce, R.W. (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Mar 1982. Contract AC06-77RL01030. 27p. (CONF-820550—4). NTIS, PC A02/MF A01. Order Number DE82015795.

From Geological Society of American Rocky Mountain section meeting; Bozeman, MT, USA (7 May 1982).

Information collected over the past 3 years, has significantly contributed to and advanced the hydrological understanding of groundwater flow systems within basalts at the Hanford Site. Hydrochemical and isotopic parameters analyzed include: major inorganics, trace elements, dissolved gas and stable and unstable isotopes. A summary of the hydrochemical data is presented. Stable isotopes are used to determine groundwater recharge areas and to determine evaporation histories of surface-water bodies. In addition they give insight to the type, origin, and age of groundwater. Deuterium, oxygen 18 and sulfur 34 have been used in these studies. Radionuclides have been used in a similar manner as stable isotopes. Discussed are uses of tritium, carbon 14, uranium, and chlorine 36 for the above mentioned purposes. (DMC)

61001 **(RHO-BWI-C—116-Vol.1) Engineering study, nuclear waste repository in basalt, Project B-301.** (Kaiser Engineers, Oakland, CA (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA)). Mar 1982. Contract AC06-77RL01030;AC06-80RL10000. 349p. NTIS, PC A15/MF A01. Order Number DE82022063.

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A conceptual design of a Nuclear Waste Repository in Basalt (NWRB) has been prepared by the joint venture of Kaiser Engineers, Inc. and Parsons Brinckerhoff Quade and Douglas, Inc. (KE/PB). The conceptual design is based on the Functional Design Criteria (RHO-BWI-CD-38, Rev. 3) prepared by Rockwell Hanford Operations (Rockwell) and revised with assistance from KE/PB. This report describes the conceptual design of the NWRB. Section 2 summarizes the major points of the report. Section 3 presents the principal design bases. Sections 4 through 8 contain detailed conceptual system design descriptions. Sections 9 through 14

describe system control and operations, safety, quality assurance, facility construction and expansion, interfacing with other facilities, and design uncertainties. Appendices contain more detailed descriptions of criteria, design development, and data, as well as acronyms and a glossary. The drawings are included as Volume II. This study describes all of the new facilities required for construction, operation, and backfilling of the mined geologic repository, and identifies existing facilities that are to be used for the NWRB. All surface facilities within the perimeter fence, the shaft, and subsurface facilities are included, and provisions are made for outside interfaces. Issues of near- and far-field nuclear waste isolation are not included in the scope of this work; they are addressed in Rockwell reports.

61002 **(RHO-BWI-C—116-Vol.2) Engineering study, nuclear waste repository in basalt, Project B-301.** (Kaiser Engineers, Oakland, CA (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA (USA)). Mar 1982. Contract AC06-77RL01030;AC06-80RL10000. 138p. NTIS, PC A07/MF A01. Order Number DE82021389.

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Volume II contains drawings of the Nuclear Waste Repository in Basalt (NWRB).

61003 **(SAND—81-7209) Far-field thermal analysis of a spent-fuel repository in tuff. Topical report RSI-0128.** Klasi, M.L.; McClain, W.C.; Brandshaug, T. (Sandia National Labs., Albuquerque, NM (USA); RE/SPEC, Inc., Rapid City, SD (USA)). Jul 1982. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01. Order Number DE82019876.

Thermal loadings of 25, 50, 75, 100 and 150 kW/acre were used for thermal analyses of a spent fuel repository at a depth of 800 m in tuff. Three methods of handling the pressure of pore water were considered; the first assumed that pore water does not boil, the second that pore water boiled in the interval 90 to 110°C, the third that pore water boiled at a temperature governed by hydrostatic pressure. It was found that hydrostatic boiling did not occur for any thermal loading considered and that boiling in the interval 90 to 110°C did not occur for a thermal loading of 25 kW/acre. The most important result was the significant suppression of maximum temperatures because of energy consumed in boiling pore water. The peak temperature suppression ranged from zero at a thermal load of 25 kW/acre to nearly 23% at 150 kW/acre.

61004 **(SAND—82-0547) Simulated-waste experiments planned for the Waste Isolation Pilot Plant (WIPP).** (Sandia National Labs., Albuquerque, NM (USA)). Jul 1982. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01. Order Number DE82022239.

The US Department of Energy manages an R and D Program to provide a technical basis for systems designs and safety and environmental assessments for future repositories of radioactive wastes resulting from US defense activities. The Waste Isolation Pilot Plant (WIPP) in southeast New Mexico is being developed with that Program as an R and D facility to demonstrate the safe disposal of such wastes in bedded salt. The Simulated-Waste Experiments (SWEs) refer to the in situ tests (without radioactivity) in the WIPP R and D Program that address the technical issues of isolating radioactive wastes in bedded salt. The SWEs include tests that concern the program areas of repository development and interactions of the waste package with the host rock. Data obtained from these tests will be used in evaluating performance assessment models and in developing a technical basis for future repository designs and operations.

61005 **(SAND—82-1176) Reference calculations for underground rooms of the WIPP.** Miller, J.D.; Stone, C.M.; Branstetter, L.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 118p. NTIS, PC A06/MF A01. Order Number DE82022234.

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Results of the first reference calculation for the Waste Isolation Pilot Plant (WIPP) project using the dynamic relaxation finite element code SANCHO are presented. The reference calculation is a two-part study involving a room design for storage of non-heat-producing nuclear waste and another for an experimental configuration with heat-producing waste. Results are presented that include relevant deformations, relative clay seam displacments, stress and strain profiles, temperature profiles, and contour plots of a conservative postprocessed measure of potential salt failure. These results will be useful for subsequent work such as for defining experiments and for developing instrumentation. Highlights of the reported results include room closure histories, which reached maximum values of 0.21 meters and 0.75 meters in the vertical direction for the isothermal and heated cases, respectively, at 10 years, and the plots of potential halite failure. No failure of the salt is likely for the heated rooms, and the only possible salt fracturing that might occur in the isothermal room is confined to a small area in the center of the room floor.

61006 **(SAND—82-1783) Basic data report for Drillhole WIPP 14 (Waste Isolation Pilot Plant - WIPP).** (Sandia National Labs., Albuquerque, NM (USA); D'Appolonia Consulting Engineers, Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 97p. NTIS, PC A05/MF A01. Order Number DE82022241.

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Borehole WIPP 14 is an exploratory well drilled in eastern Eddy County, New Mexico, in section 9, T22S,R31E. The borehole was drilled to a depth of 1000.0 ft measured from ground level. It penetrated, from top to bottom, 15.4 ft of Quaternary sands, 125.6 ft of the Triassic Santa Rosa Sandstone, and in the Permian strata, 497.7 ft of the Dewey Lake Red Beds, 312.9 ft of the Rustler Formation and 48.4 ft of the Upper Salado Formation. Seven hundred feet of the well were cored, at consecutive and nonconsecutive 10-ft intervals to a depth of 925.5 ft. Cuttings were collected where core was not taken. Density, gamma ray neutron and caliper logs were run the full depth of the hole. The WIPP is a demonstration facility for the disposal of transuranic (TRU) waste from defense programs. The WIPP will also provide a research facility to investigate the interactions between bedded salt and high level wastes.

61007 **(UCRL—87248) Influence of heat flow on drift closure during Climax granite spent-fuel test: measurements and calculations.** Butkovich, T.R.; Yow, J.L. Jr.; Montan, D.N. (Lawrence Livermore National Lab., CA (USA)). 8 Sep 1982. Contract W-7405-ENG-48. 5p. (CONF-820933—3). NTIS, PC A02/MF A01. Order Number DE82021351.

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

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Measurements of drift closure caused by the thermal load have been made routinely during the Spent Fuel Test in Climax granite since about six weeks after emplacement of the fuel. Horizontal and vertical closure was measured with a manually operated tape extensometer at various locations along the lengths of the drifts. Average closures ranged from 0 to 0.6 mm, horizontal and vertical, out to about 2.2 years since the start of the test. At the same time, displacements from the thermal loads were measured with rod extensometers emplaced to measure relative displacements between hole collars and anchor points in holes drilled from two parallel heater drifts. These data are compared with thermo-elastic finite element calculations which utilized measured properties of the Climax granite. The calculations show that more than half of the closures occur between fuel installation and the first closure measurement. The comparisons show that the results track each other, in that where closure followed by dilation is measured, the calculations also show this effect. The agreement is excellent, considering the averaged measured closures remain within 30% of the total calculated drift closures and the extremely small magnitude of the relative displacements (0.5 mm), measured or calculated.

61008 **Plutonium recovery from fuel fabrication residues.** Christensen, E.L. (LANL-U.S., Los Alamos, New Mexico 87545). *Transactions of the American Nuclear Society;* **40**: 59-63(1982). (CONF-820420—).

From International ENS/ANS conference on nuclear energy with emphasis on fuel cycles; Brussels, Belgium (26 Apr 1982).

61009 **Prepolishing of surfaces of exposure control and increased plant availability.** Allen, R.P.; Arrowsmith, H.W. (PNL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **38**: 621-622(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61010 **Magnetic filtration of reactor low-concentration-chelant decontamination, solutions.** Emory, B.B. (UNC Nucl Ind, Richland, WA 99352). *Transactions of the American Nuclear Society;* **38**: 623-624(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61011 **Electrochemical methods for leaching of spent fuel.** Wang, R.; Katayama, Y.B. (Pacific Northwest Lab., Richland, WA). *Nuclear and Chemical Waste Management;* **2**: No. 2, 147-149(1981). Contract AC06-76RL01830.

Electrochemical methods were used to study the initial dissolution and leaching behavior of spent-fuel fragments. The initial dissolution rate and the nature of the surface film of the spent fuel was shown to be compatible with those of single-crystal UO_2 surfaces. Thus, studying the behavior of UO_2 may provide an understanding of spent-fuel leaching mechanisms. Also, the study showed that spent-fuel leach data and dissolution kinetics may be obtained from the electrochemical methods described.

61012 **Evaluation of incinerators for the disposal of radioactive waste.** Thompson, J.D.; Cooley, L.R. (EG and G Idaho, Idaho Falls, ID). *Transactions of the American Nuclear Society;* **35**: 28-29(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61013 **Solute transport for radioactive wastes through the Vadose zone.** Lu, A.H. (Rockwell Hanford, Richland, WA). *Transactions of the American Nuclear Society;* **35**: 52(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 61013

61014 **(BNL-NUREG—31834) Source terms of radionuclides in shallow-land-burial sites.** Pietrzak, R.F.; Dayal, R. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 9p. (CONF-820854—12). NTIS, PC A02/MF A01.

From 4. annual DOE LLWMP participant's information meeting; Denver, CO, USA (31 Aug 1982).

A research program is under way to provide source term data on the chemical and radionuclide contents of trench waters at low level radioactive waste disposal sites and to provide information on the geochemical behavior of radionuclides under simulated field conditions. Trench waters were sampled at four commercial waste burial sites and analyzed for chemical and radionuclide constituents. The sorption, diffusion and precipitation behavior of radionuclides were studied using site specific sediments and trench waters. Radionuclide leach rates from solidified waste, under simulated trench conditions, were also determined.

0540 Health And Safety

REFER ALSO TO CITATION(S) 60986, 60987, 60989, 61627, 61654, 61738, 61965, 62011, 62131

61015 **(DOE/NBM—2020543) Safety assessment of spent fuel transportation through urban regions.** Sandoval, R.P.; Newton, G.J. (Sandia National Labs., Albuquerque, NM (USA); Lovelace Foundation for Medical Education and Research, Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). Aug 1982. Contract AC04-76DP00789;AC04-76EV01013. 11p. NTIS, PC A02/MF A01. Order Number DE82020543.

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A full scale test subjecting a 25.45 metric tonne stainless steel/lead cask containing surrogate spent fuel to a reference high explosive device was performed to provide data for developing improved estimates of the radiological consequences resulting from the sabotage of spent fuel transports in urban regions. A total UO_2 fuel mass of 5.460 kg was removed from the 201.053 kg UO_2 fuel assembly as a result of the test. A total respirable UO_2 aerosol mass of 2.94 g was released from the cask as a result of the explosive attack. The results of this full-scale test indicate that approximately 6×10^{-4} % of the total solid heavy metal inventory (0.5 t) could be released as a respirable radioactive aerosol as a result of an explosive attack on a single-PWR fuel assembly truck cask. The expected health consequences were calculated using the derived release fraction of 6×10^{-4} percent as the primary input to the consequence reactor safety model called CRAC. The results of this consequence analysis indicate that one peak latent cancer fatality and no early fatalities or early morbidities could occur as a result of this postulated radioactive release from a single PWR spent fuel truck cask in downtown New York City.

61016 **(ENICO—1118) Development of HEPA filter retention-efficiency monitor.** Hohorst, F.A.; Fernandez, S.J.; McManus, G.J. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Oct 1982. Contract AC07-79ID01675. 31p. NTIS, PC A03/MF A01. Order Number DE82022041.

This report documents the conceptual design, laboratory evaluation, and in-plant demonstration of a HEPA filter retention efficiency monitor. This monitor uses electrofluidized beds to quantitatively retain all radioactive aerosols penetrating a filter and uses NaI(Tl) detectors to measure the collected particles. Filter efficiencies $\geq$ 99.95% can be measured when plant operations generate sufficient radioactive aerosols. The effects of both normal and abnormal operating conditions on the monitor are documented.

61017 **Uranium and coal as low-cost energy sources. The safety issue.** Siddall, Ernest (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). pp 83-90 of Energy crisis: policy response. Nemetz, P.N. (ed.). Montreal, Quebec; Institute for Research on Public Policy (1981).

In the past it has been assumed that a balance must be sought between the benefits arising from a low-cost energy source and the risks associated with it. However, part of the benefit may be an increase in safety in the society; if this nullifies or exceeds the direct risk, safety is eliminated as an issue or becomes a factor in favour. A comparison of the health effects resulting from the use of coal, oil, natural gas, and nuclear power, and a comparison of mortality estimates for nuclear and coal show that nuclear power has a smaller harmful effect on human populations than other energy sources. It is possible to calculate that 416 lives have been saved in Canada each year since 1950 from electricity generation. Figures showing the relationship between low-cost energy availability and life-saving activities are presented.

0550 Regulations

REFER ALSO TO CITATION(S) 60982, 61623

61018 **(ANL—82-28) Computer-based accountability system (Phase I) for special nuclear materials at Argonne-West.** Ingermanson, R.S.; Proctor, A.E. (Argonne National Lab., IL (USA)). May 1982. Contract W-31-109-ENG-38. 113p. NTIS, PC A06/MF A01. Order Number DE82021269.

An automated accountability system for special nuclear materials (SNM) is under development at Argonne National Laboratory-West. Phase I of the development effort has established the following basic features of the system: a unique file organization allows rapid updating or retrieval of the status of various SNM, based on batch numbers, storage location, serial number, or other attributes. Access to the program is controlled by an interactive user interface that can be easily understood by operators who have had no prior background in electronic data processing. Extensive use of structured programming techniques make the software package easy to understand and to modify for specific applications. All routines are written in FORTRAN.

61019 **(ANL—82-49) NDA safeguards techniques for LMFBR assemblies.** Persiani, P.J.; Gundy, M.L. (Argonne National Lab., IL (USA)). Aug 1982. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01. Order Number DE82021235.

The significant safeguards concerns for liquid-metal fast breeder reactors (LMFBRs), and for the LMFBR fuel handling systems are the accountability, surveillance, and identification of fuel and blanket assemblies. The introduction of fuel assemblies with a high content of Pu into the receiving and shipping areas of the LMFBR fuel cycle does allow a more direct near-real-time assay profile of the disposition of Pu. Isotope correlations and neutron assay methods have been investigated and implemented for determining plutonium and burnup in fresh and spent LMFBR fuel assemblies. The methods are based on active and passive neutron coincidence counting (NCC) techniques. Preliminary studies on neutron yield rates from the spontaneous fission of plutonium and curium isotopes have indicated that the NCC system is a most effective measure in the verification of nuclear material flow in assembly form for the entire reactor fuel handling cycle, i.e., from the fresh- to the spent-fuel stage. A consequence of the high plutonium concentration level throughout the fuel irradiation period in an LMFBR, is that the spontaneous fission neutron yield from the 242-curium and 244-curium does not dominate the spontaneous fission neutron yield from the plutonium isotopes in the spent fuel stage.

61020 **(LA—9265) Materials accounting in a fast-breeder-reactor fuels-reprocessing facility: optimal allocation of measurement uncertainties.** Dayem, H.A.; Ostenak, C.A.; Gutmacher, R.G.; Kern, E.A.; Markin, J.T.; Martinez, D.P.; Thomas, C.C. Jr. (Los Alamos National Lab., NM (USA)). Jul 1982. Contract W-7405-ENG-36. 189p. NTIS, PC A09/MF A01. Order Number DE82021845.

This report describes the conceptual design of a materials accounting system for the feed preparation and chemical separations processes of a fast breeder reactor spent-fuel reprocessing facility. For the proposed accounting system, optimization techniques are used to calculate instrument measurement uncertainties that meet four different accounting performance goals while minimizing the total development cost of instrument systems. We identify instruments that require development to meet performance goals and measurement uncertainty components that dominate the materials balance variance. Materials accounting in the feed preparation process is complicated by large in-process inventories and spent-fuel assembly inputs that are difficult to measure. To meet 8 kg of plutonium abrupt and 40 kg of plutonium protracted loss-detection goals, materials accounting in the chemical separations process requires: process tank volume and concentration measurements having a precision $\leqq$ 1%; accountability and plutonium sample tank volume measurements having a precision $\leqq$ 0.3%, a shortterm correlated error $\leqq$ 0.04%, and a long-term correlated error $\leqq$ 0.04%; and accountability and plutonium sample tank concentration measurements having a precision $\leqq$ 0.4%, a short-term correlated error $\leqq$ 0.1%, and a long-term correlated error $\leqq$ 0.05%. The effects of process design on materials accounting are identified. Major areas of concern include the voloxidizer, the continuous dissolver, and the accountability tank.

61021 **(LA—9282-MS) Los Alamos Plutonium Facility implementation support project report.** Thomas, C.C. Jr.; Ford, W.; Hsue, S.T.; Marshall, R.S. (Los Alamos National Lab., NM (USA)). May 1982. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01. Order Number DE82016374.

During FY 1981 the TA-55 Implementation Support Project provided assistance to the Los Alamos Plutonium Facility in materials accounting and control, including testing and evaluation of a solution mass measurement system, development and testing of a low-level plutonium assay system, holdup measurements, instrument design, and advice and consultation following the observation of semiannual inventories. This report describes the program envisioned for FY 1982, including demonstration of the solution mass measurement system and the associated calibration system, extension of the low-level plutonium assay system to solutions with americium/plutonium ratios of 10: to 20:1, and development and demonstration of a method to calibrate and routinely verify the plutonium oxalate assay instrument performance. The FY 1982 program is subject to changes based on TA-55 reevaluation of facility needs.

61022 **(NUREG—0525-Rev.5) Safeguards Summary Event List (SSEL).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Jul 1982. 61p. GPO $4.75.

The Safeguards Summary Event List (SSEL) provides brief summaries of several hundred safeguards-related events involving nuclear material or facilities regulated by the US Nuclear Regulatory Commission (NRC). Events are described under the categories of bomb-related, intrusion, missing and/or allegedly stolen, transportation, vandalism, arson, firearms, sabotage and miscellaneous. The information contained in the event descriptions is derived primarily from official NRC reporting channels.

61023 **(UCRL—86218) Use of soft probabilities in evaluating physical-security systems.** Green, J.N. (Lawrence Livermore National Lab., CA (USA)). Mar 1982. Contract W-7405-ENG-48. 23p. (CONF-821012—1). NTIS, PC A02/MF A01. Order Number DE82016778.

From Institute for management sciences/Operations research Society of America joint meeting; San Diego, CA, USA (25 Oct 1982).

The complexity of evaluating how a physical security system would perform against a broad array of threat situations dictates the use by an inspector of methods which are not completely rigorous. Intuition and judgment based on experience have a large role to play. The use of soft probabilities can give meaningful results when the nature of the situation to which they are applied is sufficiently understood. Although the scoring method proposed is based on complex theory, it is feasible to apply on an intuitive basis. 6 figures.

06 FUSION FUELS

0602 Processing

61024 **(KMSF-U—1200) ICF research at KMS Fusion.** Glass, A.J.; Henderson, T.M.; Storm, E.K. (KMS Fusion, Inc., Ann Arbor, MI (USA)). Aug 1982. Contract AC08-78DP40030. 2p. (CONF-820930—6). NTIS, PC A02/MF A01. Order Number DE82020737.

From 9. international conference on plasma physics and controlled nulcear fusion research; Baltimore, MD, USA (1 Sep 1982).

The principal accomplishments of the KMS Fusion program over the past year are reviewed. Our activities in the area of target fabrication include both the production of high quality fuel shells, and the development of techniques for the production of special target materials.

61025 **(UCRL—86113) Physical measurements of inertial-fusion targets.** Weinstein, B.W. (Lawrence Livermore National Lab., CA (USA)). 24 Sep 1981. Contract W-7405-ENG-48. 34p. (CONF-811113—56). NTIS, PC A03/MF A01. Order Number DE82019114.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

Measurement of inertial-fusion targets has stimulated the development of many new techniques and instruments. This paper reviews the basis for selected target measurement requirements and the development of optical interferometry, optical scattering, microradiography and scanning electron microscopy as applied to target measurement. We summarize the resolution and speed which have been achieved to date, and describe several systems in which these are traded off to fill specific measurement applications. We point out the extent to which present capabilities meet the requirements for target measurement and the key problems which remain to be solved.

0603 By-products

61026 **(UCRL—87706) Thermochemical hydrogen production studies at LLNL: a status report.** Krikorian, O.H. (Beck (R.W.) and Associates, Seattle, WA (USA)). 8 Jun 1982. Contract W-7405-ENG-48. 7p. (CONF-820646—1). NTIS, PC A02/MF A01. Order Number DE82016252.

From International Energy Agency Annex 1 workshop on thermochemical hydrogen; San Diego, CA, USA (22 Jun 1982).

Currently, studies are underway at the Lawrence Livermore National Laboratory (LLNL) on thermochemical hydrogen production based on magnetic fusion energy (MFE) and solar central receivers as heat sources. These areas of study were described earlier at the previous IEA Annex I Hydrogen Workshop (Juelich, West Germany, September 23-25, 1981), and a brief update will be given here. Some basic research has also been underway at LLNL on the electrolysis of water from fused phosphate salts, but there are no current results in that area, and the work is being terminated.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

61027 **(DL/NUC/TM—58E) Design of a switchyard for the NSF isotope separator.** Malcolm, I.C.; Grant, I.S. (Science and Engineering Research Council, Daresbury (UK). Daresbury Lab.). Jan 1982. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702470.

In examining design requirements for the optics of the NSF isotope separator, first-order considerations, voltage requirements, second-order considerations, and shim coil design are discussed. The results are given of a computer study of the system comprising of quadrupole triplet, magnetic and electrostatic sectors. The effects of the accuracy in the fabrication of the electrostatic sector are considered.

0702 Radiation Sources

61028 (INIS-SU—29, pp vp) **Possibilities of short-pulsed modulation in the ionizing radiation generators with high-frequency ion sources.** Kir'yanov, G.I.; Matantsev, A.N. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Radiation technology.

It is necessary to have short transients in HF-generator, exciting dischargee to carry out short-pulsed modulation of radiation with pulse duration from one to fractions of microsecond at modulating signal effect only on HF-source of ions. Calculation of transients in HF-generator is performed. Initial amplitude of oscillation voltage on HF-self-excited generator is determined, and damping coefficient, as well as voltage pulse rise time of HF-self-excited generator, is found. Experimental and calculation dependences of transient time on voltage amplitude of modulator are presented. It is stated, that to decrease duration of transients and possibility of short-pulsed modulation during effect on HF-source of ions, it is necessary to increase amplitude of voltage pulses on the HF-self-excited generator grid, to decrease duration of modulator pulse front and to increase initial amplitude of oscillations. HF-generator frequency should be chosen from 11.6 to 15 MHz range, and gas pressure in the ion source - within 1-1.5 Pa limits. Oscillograms of modulation voltage pulses, ion current and neutron flux for neutron generators, illustrating possibilities of short-pulsed modulations, are presented.

61029 **Some remarks on dosimetry for industrial applications.** Yuan, H.C. (International Atomic Energy Agency, Vienna (Austria)). pp 49-55 of High-dose measurements in industrial radiation processing. Report of an advisory group meeting on standardization and high-dose intercomparison for industrial processing organized by the IAEA and held in Vienna, 25-29 September 1978. Vienna, Austria; International Atomic Energy Agency (1981).

From IAEA meeting on standardization and highdose intercomparison for industrial radiation processing; Vienna, Austria (25 Sep 1978).

For the quality control of routine dosimetry in industrial radiation processing the possible contributions from statistical analysis are reviewed. The use of control charts will indicate the effect of density variations of products and also the presence of impurities in reference dosemeter systems. To provide better understanding of the sources of random errors the deviation of dosimetry data can be traced through the analysis of variance. A further insight into the interaction of controlled variables during irradiation may be approached through the use of response surface technology which is based on the use of an empirical equation to define the effect of variables in dose measurements.

61030 **Techniques used by the Center for application and promotion for ionizing beams for the dosimetry of gamma radiations and electron beams.** Laizier, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Office des Rayonnements Ionisants). pp 57-68 of High-dose measurements in industrial radiation processing. Report of an advisory group meeting on standardization and high-dose intercomparison for industrial processing organized by the IAEA and held in Vienna, 25-29 September 1978. Vienna, Austria; International Atomic Energy Agency (1981). (In French)

From IAEA meeting on standardization and highdose intercomparison for industrial radiation processing; Vienna, Austria (25 Sep 1978).

The activities carried out by the center CAPRI (CEA - SACLAY), which concern the industrial applications of ionizing beams, imply the use of a large variety of different irradiation methods. This paper presents the methods used for the dosimetry; in particular the properties and performances of the film TAC as dosimeter are described.

61031 **Unified control methods in dosimetry for high-activity irradiation facilities in Hungary.** Stenger, V. (Magyar Tudomanyos Akademia, Budapest. Izotopintezete). pp 81-96 of High-dose measurements in industrial radiation processing. Report of an advisory group meeting on standardization and high-dose intercomparison for industrial processing organized by the IAEA and held in Vienna, 25-29 September 1978. Vienna, Austria; International Atomic Energy Agency (1981).

From IAEA meeting on standardization and highdose intercomparison for industrial radiation processing; Vienna, Austria (25 Sep 1978).

The increasing interest in the application of ionizing radiation raised not only the number but also the capacity of the facilities in Hungary, and presented the problem of measuring 10 to 100kGy/h dose rate, and doses in the range 50Gy to 1MGy. For the mapping of the exposure field of laboratory facilities the well-known and internationally-accepted Fricke dose meter was introduced. For the high dose rate and dose control different chemical dose meters were introduced, such as the ethanol-chlorobenzene dose meter. This method of evaluation turned out to be too slow for industrial processes and an evaluation method by oscillometry was developed. The ethanol-chlorobenzene dose meter became, for practical and industrial use, a simple, easily applicable method in several countries. Economy of mapping exposure fields is claimed for simple and rapid evaluation, thus computer programs were worked out using semiconductor rate meters for the determination

of relative dose rates. All the methods applied and introduced in the Institute were compared with others introduced abroad in international cooperation. On the basis of the methods of dosimetry carried out in the Institute of Isotopes of the Hungarian Academy of Sciences unified control methods have been introduced in Hungary for high-activity cobalt-60 irradiation facilities and processes, such as preparation of exposure rate maps and tables, application of 'test dosimetry' in pilot and industrial irradiators, process control dosimetry, process control by semiconductors, and process control by dose indicators.

0703 Isotopic Power Supplies

61032 (MLM—2980) Behavior of oxygen partial pressure over slightly substoichiometric plutonia at 1410°K. Johnson, E.W. (Mound Facility, Miamisburg, OH (USA)). 31 Aug 1982. Contract AC04-76DP00053. 11p. NTIS, PC A02/MF A01. Order Number DE82021998.

Monsanto Research Corporation is charged with processing encapsulated plutonium dioxide heat sources into radioisotopic thermoelectric generators (RTGs) to support deep-space missions. One of the problems associated with the sometimes protracted ground storage of these devices is the ingrowth of carbon dioxide and carbon monoxide in the gas phase due to the cyclical reaction established between the fuel ($^{238}PuO_2$) and the carbon impact body. This ingrowth proceeds according to the two equations: x(CO) + <PuO_2> = x(CO_2) + < PuO/sub 2-x/ and x(CO_2) + x < C > = 2x(CO), etc. To reduce this effect, a gas management system was instituted that enabled periodic removal of the generated CO and CO_2 with replacement by argon. The removal of these components was monitored and permitted an assessment of the degree of substoichiometry as well as its effect on the chemical activity of the CO and CO_2. This in turn was used to estimate the oxygen activity and to calculate Δ anti G(O_2) as a function of stoichiometry.

08 HYDROGEN

61033 (DOE/CE—034) Summary of DOE Hydrogen Program FY-1981 by the Hydrogen Energy Coordinating Committee. (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Vehicle and Engine Research and Development). Jul 1982. 52p. NTIS, PC A04/MF A01. Order Number DE82020494.

The FY 1981 Summary is the fourth consecutive yearly report on all hydrogen-related programs within DOE. The report provides an annual overview of the hydrogen-related programs of the DOE offices represented in the Hydrogen Energy Coordinating Committee. A historical summary of hydrogen budgets of these offices is given. The distribution by program element for FY 1981 is given. The DOE hydrogen total for research funding in FY 1981 was $30.9 million. The Nuclear Power System budget numbers are the portion of the high-temperature gas reactor programs with potential application to hydrogen production. These figures are omitted from the totals because the work is only indirectly related to hydrogen. Present DOE hydrogen research focuses on its use as an energy storage medium and as a general purpose fuel. The individual program elements of the DOE hydrogen programs are described in the body of this report. More specific program information is given in the Technology Summary Forms in Appendix A. In some cases, these forms show funding levels beyond FY 1981. These figures reflect program planning estimates and should not be considered as final budgets. A report issued by the US General Accounting Office, entitled The Potential for Hydrogen as an Energy Source, discusses the present status and future prospects of the utilization of hydrogen as a fuel and is included in Appendix B.

0801 Production

REFER ALSO TO CITATION(S) 61026, 61680, 61683

61034 (BNL—31666) Current research in advanced water electrolyzer in the United States and abroad. Bonner, M.; Botts, T.; McBreen, J.; Mezzina, A.; Salzano, F.; Yang, C. (Brookhaven National Lab., Upton, NY (USA)). Jul 1982. Contract AC02-76CH00016. 6p. (CONF-820814—29). NTIS, PC A02/MF A01. Order Number DE82021744.

From 17. Intersociety Energy Conversion Engineering conference; Los Angeles, CA, USA (8 Aug 1982).

An overview on advanced water electrolysis systems for H_2 production is provided. The survey of the work sponsored by the Department of Energy through Brookhaven National Laboratory (BNL) includes: General Electric's scale-up of SPE technology; Teledyne's identification of the best available electrodes and separators for advanced alkaline systems; Life Systems' testing of a novel static water feed concept; and advanced electrolysis research at BNL. Also included is recent progress in Canada, Europe (development of inorganic ion exchange membranes), and Japan (alkaline and SPE plants) which is based on information reported to the International Energy Agency.

61035 (BNL—31724) Test bed for advanced hydrogen technology: photovoltaic array/electrolyzer system. Strickland, G. (Brookhaven National Lab., Upton, NY (USA)). Aug 1982. Contract AC02-76CH00016. 6p. (CONF-820827—18). NTIS, PC A02/MF A01. Order Number DE82021745.

From Energy storage contractors review meeting; Arlington, VA, USA (23 Aug 1982).

The primary objective of the project is to establish an integrated test bed that will illustrate advanced technology for the far term. Installation of the test bed would be at the site of the Hydrogen-Technology Advanced-Component Test System (HYTACTS), a service system constructed several years ago and used for testing a hydride-hydrogen storage vessel capable of storing 50 lb of hydrogen as a metal hydride. The HYTACTS provides services essential for hydrogen flow, as well as those for thermal control. Most operations are performed remotely from an indoor control panel outfitted with suitable instrumentation. A second objective of the project is to test and evaluate the photovoltaic array/advanced technology electrolyzer (PVA/ATE) system under practical conditions. Operation of the ATE in the transient mode, as determined by the local insolation, is the key part of the experimental program. At an appropriate time, IEA participants and interested commercial parties will be invited to operate the system as a tutorial exercise. Subsequently, a decision will be made on modifying the system for stand-alone operation. The performance evaluation will aid in guiding system optimization and in planning project activities on renewable-resource energy conversion. This report presents essential information on the project design/planning activity leading to the installed test bed, and on design of the experimental program leading to system evaluation.

61036 (BNL—51577) Integrated test bed for advanced hydrogen technology: photovoltaic array/electrolyzer system. Strickland, G.; Schoener, G.A. (Brookhaven National Lab., Upton, NY (USA)). Jul 1982. Contract AC02-76CH00016. 64p. NTIS, PC A04/MF A01. Order Number DE82020921.

A design/planning study was conducted on the construction and testing of a photovoltaic array/water electrolyzer system. This study represents the first phase of a project to develop an integrated test bed at BNL to serve as a technical illustration of coupling a state-of-the-art photovoltaic array to an advanced-technology electrolyzer. The study includes plans to test, demonstrate, and evaluate the system in several operating modes, especially under transient conditions. In the proposed system a 15-kW electrolyzer is powered by a 5-kW array in combination with rectified ac power via a power conditioner, thereby simulating 100% solar power. Other operating modes consist of 100% ac operation for acceptance and baseline tests, and constant power tests using both energy sources. The hydrogen produced will be stored as a metal hydride, or, vented until an end-use device, such as a hydrogen/air fuel cell is available for testing the energy reconversion step. All of the components will be purchased and installed by contractors; and BNL personnel will manage the contracts and operate the completed system. Final design and construction, as well as various programmatic requirements, including a safety review, acceptance tests and

operator training, are to be completed within 12 months after project implementation. The 2-year experimental program will also provide for a period of tutorial operation for qualified participants; and consideration will be given to converting the system, on a reduced scale, to stand-alone operation. Evaluation of the test results will be used in planning future activities in converting and storing solar energy to environmentally desirable energy forms.

61037 **(EUR—7038-DE) Thermochemical hydrogen production, separating process.** Cremer, H.; Knoche, K.F.; Wozny, G. (Commission of the European Communities, Luxembourg. Directorate-General for Research, Science and Education). 1981. 130p. (In German). Commission of the European Communities, Luxembourg.

A program to calculate equilibrium plate columns has been developed and tested. Routines and balances have been established on the basis of the material data published for H_2SO_4, H_2O, SO_3, SO_2 and O_2. A program system has been established and tested for calculation and correlation of the phase equilibrium. An approach for free excess enthalpy has been developed to calculate activity coefficients for strong and weak electrolytes in aqueous solution; the approach enables a simple correlation for new measured data.

61038 **(EUR—7386-IT) New separators for water electrolysis. Final report.** Giuffre, L.; Modica, G.; Hua-Liang, Z.; Tempesti, E. (Politecnico di Milano (Italy). Ist. di Chimica Industriale). 1981. 114p. (In Italian). European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037.

A description is given of the study, development, testing, and prospective use of styrene, divinylbenzene sulfonate, and polyphenylene sulfur sulfonate polymers to be used as separators for water electrolysis. Tabulated data are presented on the reproducibility of polymerization and material strength testing. 42 figures, 39 tables.

0802 Storage

REFER ALSO TO CITATION(S) 61035

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 60833, 60835, 60854, 61072, 61084, 61102, 61735, 61850, 61858

61039 **Effects of dispersion on the activity and selectivity of alumina-supported ruthenium catalysts for carbon monoxide hydrogenation.** Kellner, C.S.; Bell, A.T. *Journal of Catalysis;* **75**: No. 2, 251-261(Jun 1982). Contract W-7405-ENG-48.

A study was performed to determine the extent to which metal dispersion affects the activity and selectivity of Ru/Al_2O_3 catalysts used for CO hydrogenation. For dispersions below 0.7, the specific activity for synthesis of methane and C/sub 2+/ products decreases with increasing dispersion, but neither the probability for chain growth nor the olefin-to-paraffin ratio is affected. The decrease in activity over this range is ascribed to a decrease in the fraction of sites present on planar surfaces. For dispersions above 0.7, the specific activity for synthesis of all products decreases dramatically, and is accompanied by a slight decrease in the probability of chain growth and a rapid decrease in the olefin-to-paraffin ratio. These changes are attributed to changes in the electronic properties of the Ru microcrystallites with size and the occurrence of metal/support interactions.In situ infrared spectra reveal that only those sites that adsorb one linearly bound CO molecule per Ru atom are active for CO hydrogenation. Adsorption of two CO molecules per Ru site is also observed but these site are catalytically inactive.

61040 **Methane production from the catalyzed reaction of graphite and water vapor at low temperatures (500-600 K).** Cabrera, A.L.; Heinemann, H.; Somorjai, G.A. (University of California, Berkeley). *Journal of Catalysis;* **75**: No. 1, 7-22(May 1982). Contract W-7405-ENG-48.

The steady-state production of methane from the catalyzed reaction of high-density graphite and water vapor at low temperatures (500-600 K) is reported. The reaction is catalyzed by potassium hydroxide and potassium carbonate placed on the graphite surface. The steady-state production of methane has a turnover frequency of 10^{-3} sec^{-1} at 522 K and as activation energy of 10 +/- 3 kcal/mole. Several other alkali hydroxides, lithium, sodium, and cesium hydroxide, all turned out to be good catalysts for the production of methane from water vapor and graphite. The surface composition and surface texture were characterized by Auger electron spectroscopy and scanning electron microscopy, respectively.

61041 **Conversion of biomass to fuels by thermal process.** Hatt, B.W.; Bridgwater, A.V. *Report - Watt Committee on Energy;* No. 5, 61-68(Jun 1979). (NP—2902755).

The conversion of biomass to fuels by thermal processes is discussed. These processes include pyrolysis, gasification, hydrogasification, and hydrogenation. The gas, liquid, and solid products are studied as well as the conversion of the products to high quality fuels, i.e. methane, methanol, hydrocarbons, hydrogen, and higher alcohols. The effect of feed, reactor variables and reactor type on the products, the efficiency of the thermal process, and the state-of-the-art technology in thermal processing are also discussed. (MJF)

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 60750, 60854, 61041, 61068, 61074, 61084, 61102, 61735, 61751, 61850

61042 **Hydrogen fluoride saccharification of wood: lignin fluoride content, isolation of α-D-glucopyranosyl fluoride and posthydrolysis of reversion products.** Hardt, H.; Lamport, D.J.A. (Michigan State Univ., East Lansing). *Biotechnology and Bioengineering;* **24**: No. 4, 903-918(Apr 1982). Contract AC02-76ER01338.

Wood chips from bigtooth aspen (Populus grandidentata Michx.) were saccharified by reaction with hydrogen fluoride either anhydrous or containing up to 10% v/v water. The reaction products were separated into a solid lignin fraction and a water-soluble saccharide fraction. The fluoride content of the lignin (determined after alkaline fusion) was initially about 1 mg/g wood, but was lowered to 0.1 mg/g wood by grinding and washing. Thus little or no chemical binding of fluoride to lignin occurred during hydrogen fluoride (HF) solvolysis. Analysis of the water-soluble fraction by gel filtration on Biogel P2 columns showed a range of low-molecular-weight oligosaccharides an only 10-20% sugar monomers. Thus considerable reversion occurred during HF evacuation. Posthydrolysis conditions were optimized for these reversion products by varying temperature and acid concentration. Optimal conditions at 1 h were 140°C with 100mN sulfuric acid or 225mN hydrofluoric acid resulting in monomer yields of > 90% for 0.5% sugar solutions and > 80% for 10% sugar solutions. After reaction of pure cellulose (filter paper) with hydrogen fluoride in the absence of water, and terminating the reaction with calcium carbonate, the reaction intermediate α-D-glucopyranosylfluride was isolated with a maximal yield of 0.2 g/g paper. Upon purification via paper chromatography glucosyfluoride was identified by its specific rotation and also by gas chromotography-mass spectrometer of its tetra-O-trimethylsilyl derivative.

61043 **Fuel alcohol production from biomass.** Emery, A.N.; Kent, C.A. *Report - Watt Committee on Energy;* No. 5, 45-59(Jun 1979). (NP—2902755).

The present and future methods of alcohol production are discussed. Three ways of improving the net energy production of the conversion are presented: (1) increasing the alcohol concentration; (2) improving the thermal efficiency of the distillation; and (3) using by-products of the conversion process to provide energy for processing. Mono- and di-saccharides, starchy raw materials, and cellulosic raw materials are examined as raw materials for alcohol

production. The costs of ethanol production from biomass is also discussed. (MJF)

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 60854, 61091, 61092

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 61672

61044 **(DOE/RA—23211) Goodyear Lake Hydroelectric Generating Station redevelopment final construction and cost report. DOE small-scale hydroelectric demonstration program.** (F.W.E. Stapenhorst, Inc., Pointe Claire, Quebec (Canada)). 1982. Contract FC07-79RA23211. 122p. NTIS, PC A06/MF A01. Order Number DE82021530.

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This project is one of the US Department of Energy's original seven low-head hydroelectric demonstration projects. The demonstration project was initiated by the release of a Program Opportunity Notice (PON) ET-78-N-07-1711 dated November 1, 1978. The purpose for the demonstration is to show the feasibility of small hydroelectric power development projects at a number of existing dam sites across the country. The Goodyear Lake Power Station provided an excellent example of the redevelopment of a discontinued low-head hydroelectric facility. The dam and power station were previously owned by the New York State Electric and Gas Corporation. Prior to F.W.E. Stapenhorst's involvement, it was the Utility's intention to breach the dam and dewater the lake. In order to rehabilitate the power station, title was transferred to F.W.E. Stapenhorst Inc., upon finalization of a Power Agreement (whereby F.W.E. Stapenhorst Inc. would sell the power generated to New York State Electric and Gas Corporation) and issuance of the FERC license. The station, as renovated, is fully automatic and utilizes two Ossberger Cross-Flow type turbines - turbines which, due to their flat efficiency curve, are well suited for small rivers and streams where the flow varies over a wide range. Both technical and financial feasibility of the project were carefully analyzed prior to the commencement of the project. The US Department of Energy awarded a cooperative agreement whereby DOE would share $245,000 of the project costs. The Goodyear Lake Station was the first demonstration project under the auspices of the Department of Energy to achieve power-on-line and to be officially dedicated.

61045 **(IDO—1735-1) Low-head hydro: an examination of an alternative energy source.** Gladwell, J.S.; Warnick, C.C. (comps.). (Idaho Univ., Moscow (USA). Water Resources Research Inst.). Sep 1978. Contract EG-77-C-07-1735. 205p. NTIS, PC A10/MF A01. Order Number DE82021807.

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The impact of fossil fuel shortages and of increased energy demand among the world's populations on low-head hydroelectric power development is reviewed followed by a discussion of the economics, legal and institutional aspects, turbine design requirements, environmental impacts, and energy potential of low-head hydropower plants. (LCL)

1305 Economics And Management

REFER ALSO TO CITATION(S) 61057, 61239

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 61672

1401 Resources And Availability

61046 **(EUR—7312-FR) Estimation of daily solar irradiation on oriented and inclined receiver surfaces. Final report.** Dogniaux, R.; Lemoine, M. (Institut Royal Meteorologique de Belgique, Brussels). 1981. 237p. (In French). European Community Information Service, 2100 M Street, N.W., Suite 707, Washington, DC 20037.

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Tabulated and graphic results are given for studies made of estimating the available solar energy on oriented and inclined surfaces based on observations during solar insulation and irradiation on a horizontal surface. A comparison is made of the computed results with that of adopted models and available data in various European countries. Appendices contain tables which reflect the total daily irradiation in relation to daily global horizontal irradiation through clear sky as a function of the atmospheric turbidity factor and the Albedo. 5 references, 64 tables.

61047 **(SERI/TP—254-1653) Availability of sunlight in the United States.** Robbins, C.; Hunter, K. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1982. Contract AC02-77CH00178. 5p. (CONF-820928—2). NTIS (US Sales Only). Order Number DE82018194.

From International passive and low-energy alternatives conference; Bermuda, Bermuda (5 Sep 1982).

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Presented is a model developed to establish the computed probability of having sunlight in a given hour or for a specific duration of time for select cities in the United States.

61048 **(SERI/TR—215-1519) Results of a training exercise in the comparison and calibration of pyranometers and pyrheliometers.** Myers, D.R. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1982. Contract AC02-77CH00178. 70p. NTIS, PC A04/MF A01. Order Number DE82022229.

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An intercomparison and calibration exercise involving the National Weather Service (NWS), participants in the Solar Energy Meteorological Research and Training Sites Program (SEMRTS), and the Solar Energy Research Institute (SERI) was conducted at the NWS Forcast Office in Burlington, Vermont. The exercise involved applying classical comparison and calibration techniques to pyranometers and pyrheliometers. As well as demonstrating the techniques for acquiring and reducing calibration data, analysis of the data indicates the relative performance of the instruments tested and the effects of the radiation distribution and meteorological parameters on the calibrations. Variability in calibration results within a day amounted to +- 5.0% and was repeatable from day to day within about +- 2.0%. The solar evaluation angles were between 35 and 68°, and the diffuse-to-global radiation ratio was on the order of 20%.

61049 **(SERI/TR—642-1149) Terrestrial solar spectral data sets.** Bird, R.E.; Hulstrom, R.L. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1982. Contract AC02-77CH00178. 35p. NTIS, PC A03/MF A01. Order Number DE83000504.

Needed solar spectra irradiance data sets, which are representative of solar spectra under average conditions in the United States, are made available. Two new spectral irradiance data sets were created to update two standards that were proposed to the American Society for Testing and Materials. One data set is for the direct normal irradiance within a 5.8° field of view, and the other set is for the global irradiance falling on a flat surface (180° field of view). The data were generated from a new extraterrestrial spectrum and a Rayleigh scattering calculation. These data can be used to compare the performance of solar products, and also can be used to evaluate absorptance, reflectance, transmittance, and responses of various devices and materials.

61050 **(SOLAR/0010—82/08) August 1982 environmental data for sites in the National Solar Data Network.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1982. Contract AC01-79CS30027. 103p. NTIS, PC A06/MF A01. Order Number DE83000066.

Environmental data are tabulated for 26 sites in the National Solar Data Network for the reporting month. Data provided include insolation, temperature, wind, and humidity. Included is a technical discussion of the instruments used to obtain the data. (LEW)

61051 **(WMO—557-VOL-2) Meteorological aspects of the utilization of solar radiation as an energy source. Part 2: annex, world maps of relative global radiation.** (World Meteorological Organization, Geneva (Switzerland)). 1981. 33p. NTIS (US Sales Only) - hard copy available at WMO, Geneva, Switzerland.

World maps are presented from which the monthly and annual global radiation can be derived, and an overall picture of the distribution of solar radiation as an energy source can be evolved. The radiation reaching the surface of the Earth in the absence of clouds and the atmosphere was calculated from pure astronomical relationships. Results are given in MJ/sq m by 5 deg of latitude. The establishment of an empirical relationship between satellite brightness data and the relative global radiation (defined as the percentage ratio of actual surface global radiation to the astronomically possible global radiation), using available surface global radiation data as reference values, is suggested.

61052 **Meteorological aspects of the utilization of solar radiation as an energy source, part 1.** Geneva, Switzerland; World Meteorological Organization (1981). 311p. World Meteorological Organization, Geneva, Switzerland.

Meteorological knowledge and activities related to the harnessing of solar energy are treated. The development of the utilization of various forms of energy by human society is reviewed along with WMO activities in support of the rational use of energy, with special regard to solar radiation. Specific actions by which meteorological services can contribute to the utilization of solar energy are pointed out. User requirements for meteorological data are set how the data is presented and where it can be obtained are shown. Techniques for the measurement of solar radiation, including the calibration of instruments and quality control of data, are discussed while other meteorological parameters required (air temperature, wind speed, humidity, cloud amount, etc.) are also considered. The retrieval of past data, interpolation methods for the estimation of solar radiation, and publishing and archiving data are dealt with.

1403 Economics

REFER ALSO TO CITATION(S) 61744

61053 **(DOE/CS/30013—U10) Residential utility rate guide for SOLCOST data bank cities, Winter 1981-1982.** Lambert, S. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). 1982. Contract FG01-79CS30013. 639p. NTIS, PC A99/MF A01. Order Number DE82020563.

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The SOLCOST program is a systems analysis program of the Department of Energy. This program allows a new simplified design method for residential and light commercial solar heating and cooling. SOLCOST can also provide optimum size and performance characteristics for solar heating, cooling and service hot water systems, including cost comparisons between solar and conventional systems. It also performs heat load analysis for buildings and can be used for comparative energy and economic analyses for various geographic regions and for different heating, ventilation and air conditioning (HVAC) systems and energy alternatives. The current residential utility rate for the location being considered is one of the parameters needed for the SOLCOST design method. The document gives the residential rates for electricity and natural gas for each city. It shows company name, customer and minimum charges, the fuel cost adjustment, taxes, surcharges, and the date which the data is current. Rate structures for each company are shown as quoted by that company. Computations have been made for each step showing the total without charges and taxes, the total with charges and taxes, the cost per kilowatt-hour or cubic foot, and the cost per million Btu with charges and taxes. The user must be aware of some unusually high costs-per-unit when considering rates for low consumptions. These rates can be misleading due to the addition of customer or additional charges.

61054 **(DOE/CS/30013—U11) Residential energy costs for SOLCOST data bank cities, Winter 1981-1982.** Holder, R.R. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). 1982. Contract FG01-79CS30013. 145p. NTIS, PC A07/MF A01. Order Number DE82020560.

The SOLCOST program is a systems analysis program of the Department of Energy. This program allows a new simplified design method for residential and light commercial solar heating and cooling. SOLCOST can also provide optimum size and performance characteristics for solar heating, cooling and service hot water systems, including cost comparisons between solar and conventional systems. It also performs heat load analysis for buildings and can be used for comparative energy and economic analyses for various geographic regions and for different heating, ventilation and air conditioning (HVAC) systems and energy alternatives. The current residential utility rate for the location being considered is one of the parameters needed for the SOLCOST design method. The document gives the residential rates for electricity and natural gas for each city. It shows company name, customer and minimum charges, the fuel cost adjustment, taxes, surcharges, and the date which the data is current. Rate structures for each company are shown as quoted by that company. Computations have been made for each step showing the total without charges and taxes, the total with charges and taxes, the cost per kilowatt-hour or cubic foot, and the cost per million Btu with charges and taxes. The user must be aware of some unusually high costs-per-unit when considering rates for low consumptions. These rates can be misleading due to the addition of customer or additional charges.

61055 **(NASA-CR—165287) International market assessment of stand-alone photovoltaic power systems for cottage industry applications. Final report.** Philippi, T.M. (IIT Research Inst., Chicago, IL (USA)). Nov 1981. 290p. NTIS, PC A13/MF A01.

The final result of an international assessment of the market for stand-alone photovoltaic systems in cottage industry applications is reported. Nonindustrialized countries without centrally planned economies were considered. Cottage industries were defined as small rural manufacturers, employing less than 50 people, producing consumer and simple products. The data to support this analysis were obtained from secondary and expert sources in the U.S. and in-country field investigations of the Philippines and Mexico. The near-term market for photovoltaics for rural cottage industry applications appears to be limited to demonstration projects and pilot programs, based on an in-depth study of the nature of cottage industry, its role in the rural economy, the electric energy requirements of cottage industry, and a financial analysis of stand-alone photovoltaic systems as compared to their most viable competitor, diesel driven generators. Photovoltaics are shown to be a better long-term option only for very low power requirements. Some of these uses would include clay mixers, grinders, centrifuges, lathes, power saws and lighting of a workshop.

61056 **(NASA-CR—168432) Normative price for energy from an electricity generation system: an owner-dependent methodology for energy generation (system) assessment (OMEGA). Volume 1: summary.** Chamberlain, R.G.; Mcmaster, K.M. (Jet Propulsion Lab., Pasadena, CA (USA)). Oct 1981. 62p. NTIS, PC A04/MF A01.

The utility owned solar electric system methodology is generalized and updated. The net present value of the system is determined by consideration of all financial benefits and costs (including a specified return on investment). Life cycle costs, life cycle revenues, and residual system values are obtained. Break even values of system parameters are estimated by setting the net present value to zero. While the model was designed for photovoltaic generators with a possible thermal energy byproduct, it applicability is not limited to such systems. The resulting owner-dependent methodology for energy generation system assessment consists of a few equations that can be evaluated without the aid of a high-speed computer.

61057 **(SERI/TR—09275-2) User's guide to SERICOST: a computer program for estimating electric utility avoided cost.** (Solar Energy Research Inst., Golden, CO (USA); Madison Consulting Group, WI (USA)). May 1982. Contract AC02-77CH00178. 91p. NTIS, PC A05/MF A01. Order Number DE82016380.

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Computer models have been developed that can be used to estimate technology-specific avoided cost rates for electric utility purchases from qualifying distributed power producers, as required by Section 210 of the Public Utility Regulatory Policies Act of 1978. SERICOST is a modified version of MARGINALCOST, the marginal cost estimation model. SERICOST calculates the electric utility's avoided cost by time period, independent of the type of technology used by the qualifying facility. SERICOST and the companion model SERICPAC, used in combination, calculate average annual avoided cost rates for wind turbines, low-head hydro facilities, and several biomass systems.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 62009

61058 **Use and implementation of solar energy equipment standards.** Lawrence, W.; Minan, J. *Solar Law Reporter;* 3: No. 5, 781-807(Jan 1982).

The concept of standards is discussed followed by the development and uses of solar standards. The concept of voluntary standards is treated and it is pointed out that most standards in the USA are produced through the voluntary consensus system. Organizations involved in preparing standards for solar energy equipment (ASTM, ASHRAE, ASME, UL, ANSI) are described and it is pointed out that the solar industry could operate through voluntary industry participation. Mandatory standards and their imposition by state and federal governments are discussed in detail. Laws passed by California and Minnesota are used as examples. Factors such as building codes, tax incentives, information disclosure, guidelines, test methods, certification programs, and installation practices are discussed. It is concluded that, to avoid proliferation of too many separate sets of standards, Congress should consider requiring states to adopt nationwide standards that are flexible to apply in all regions (once such standards are derived). 115 references. (MJJ)

61059 **Performance warranties for residential and light commercial PV systems.** Eisenstadt, M. *Solar Law Reporter;* 3: No. 4, 607-608(Nov 1981).

Photovoltaic (PV) manufacturers are providing warranties for their products. These warranties are regulated by federal and state laws; however, it appears that most PV manufacturers are unaware of the applicable laws and are therefore exposing themselves to unintended liability as well as leaving their customers somewhat uncertain about their warranty rights. The requirements of warranties for PV systems are examined, and methods for economically verifying the performance of a PV system are discussed. A model warranty for PV manufacturers is included.

61060 **Oil companies and photovoltaics: a potential monopoly.** Wilcox, R.L. *Solar Law Reporter;* 3: No. 4, 703-727(Nov 1981).

Oil companies are rapidly acquiring a huge share of the photovoltaics (PV) industry, causing concern by some solar advocates that PV ultimately might be controlled by large companies with no immediate incentive to develop the technology. A review of antitrust laws reveals they are only minimally applicable to a new field such as PV. Federal legislation preventing further oil company investments is not necessarily the best approach to keeping the PV industry healthy, financially as well as competitively. Instead, the government should encourage competition by providing financial assistance for small PV businesses.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 60854, 61041, 61042, 61043, 61147, 61153, 61734, 61735, 61751, 62072, 62083, 62099, 62109, 62167, 62177

61061 **(DOE/CS/20120—T1) Evacuated tubular collector design study. Final technical report, 30 June 1978-30 June 1981.** (RCA Corp., Camden, NJ (USA); RCA Government Systems Div., Camden, NJ (USA). Advanced Technology Labs.). Oct 1981. Contract AC04-78CS20120. 103p. NTIS, PC A06/MF A01. Order Number DE82013961.

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The applicability of combining evacuated photothermal (PT) collectors with amorphous silicon (a-Si) photovoltaic (PV) collectors into a hybrid photovoltaic photothermal (PV/T) collector has been explored. A state-of-the-art a-Si:M PV cell was formed on an electroplated black chrome selective absorber that exhibited 4.5% electrical efficiency at room temperature. A breadboard a-Si:H coater for four foot long collector tubes was developed. Eight collector tubes were coated over a commercial, vapor deposited, Al_2O_3/Al interference film selective absorber. This effort led to an improved a-Si:H coater design for future work. The thermal performance of the coated tubes was measured in an outdoor calorimeter. The thermal collector efficiency versus temperature difference was determined both before and after stagnation testing. The collector tubes were stagnation tested for three months. A small decrease in performance was found. A very practical means of stagnation temperature control to protect future PV cells was evolved. This method used hydrogen absorption/desorption from a reversible getter to cycle the vacuum between soft and hard. A comprehensive multinode computer model was developed for evacuated tubular PV/T structures. This model was used to predict General Electric PT collector performance accurately. This model readily provides predicted thermal and electrical efficiency versus temperature difference curves for any collector design or combination of properties. With this model, ir reflection, antireflection and reflector performance variations were studied. A Systems Benefit Analysis of the PV/T concept, as seen by today's avacuated PT collector operators, was conducted. The unanimous conclusion was that an evacuated PV/T would be very highly accepted. A Technical Development Plan for future programs to bring this PV/T concept to commercial reality was developed.

61062 **(DOE/ET/20279—189) Final PV module degradation-analysis report.** Themelis, M.P. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Jun 1982. Contract AC02-76ET20279. 60p. NTIS, PC A04/MF A01. Order Number DE82021123.

Visual and electrical degradation analyses were performed on 47 modules from: the Natural Bridges National Monument (NBNM) in Utah; Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts; and the University of Nebraska at Mead, Nebraska. Such problems as discoloration, cracking, scratches, and electrical degradation were detected. (LEW)

61063 **(DOE/ET/20415—4) Thin-film cadmium sulfide/mixed copper ternary heterojunction solar cells. Technical progress report, September 30, 1977-September 30, 1978.** Loferski, J.J.; Shewchun, J.; Roessler, B.; Vitale, G.; Gorska, M.; Piekoszewski, J.; Beall, J.; Beaulieu, R.; Ercil, Y. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1978. Contract AC03-77ET20415. 35p. NTIS, PC A03/MF A01. Order Number DE82021085.

The objective of the work reported is to fabricate efficient thin-film photovoltaic cells in which one of the semiconductors is cadmium sulfide and the other is an alloy of two or more copper ternary chalcopyrite semiconductors of the type $CuInS_2$, $CuInSe_2$, etc. The alloys are chosen to provide perfect lattice matching with CdS. By recourse to pentenary alloys of the type Cu/sub x/Ag/sub 1-x/InS_2/sub z/Se_2/sub (1-z)/ it is possible within certain constraints to adjust energy gap and lattice constant independently. A goal of the program is to identify alloys of this type having perfect lattice matching with respect to CdS and energy gap of approximately 1.5 eV and to fabricate solar cells with this material as one of the constituents. Materials synthesis for use in sputter targets and

thin film preparation are discussed. Films were prepared by r-f sputtering, vacuum evaporation, neutral argon beam sputtering, and spray pyrolysis. Also discussed are attendance of meetings, presentations of papers and publications, planned activity for the next period. Contract activities are summarized from the time of initiation. (LEW)

61064 **(DOE/JPL—1012-74) Price estimates for the production of wafers from silicon ingots.** Mokashi, A.R. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Sep 1982. Contract AI01-76ET20356. 30p. (JPL-PUBL—82-65). NTIS, PC A03/MF A01. Order Number DE83000452.

Some photovoltaic modules are made from solar cells using ribbon silicon. Most solar cells, however, are produced from wafers sliced from crystalline silicon ingots. Unfortunately, the cost of the slicing process is a major part of the cost of producing silicon sheet. Any attempt to reduce the cost of photovoltaic modules, therefore, must involve the development of less expensive wafering technologies. This study presents the current status (1981) of the inside-diameter sawing, (ID), multiblade sawing (MBS) and fixed-abrasive slicing technique (FAST) processes with respect to the estimated price each process adds on to the price of the final photovoltaic module. The expected improvements in each process based on the knowledge of the current level of technology, are projected for the next two to five years and the expected add-on prices in 1983 and 1986 are estimated. Assuming that the projected progress is made, the ID and FAST processes are expected to achieve the price allocation of $18.15/m^2$ for square ingots and $13.70/m^2$ for circular ingots to conform with the earlier price goal of the Flat-Plate Solar Array Project (FSA) of $0.70/W/sub p/ of PV module (price estimates are expressed in 1980 dollars). MBS technology projections, however, indicate that its progress will not be sufficient to achieve the allocated price goal before 1986.

61065 **(DOE/JPL—1012-75) User handbook for Block IV silicon-solar-cell modules.** Smokler, M.I. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Sep 1982. Contract AI01-76ET20356. 59p. (JPL-PUBL—82-73). NTIS, PC A04/MF A01. Order Number DE83000453.

The essential electrical and mechanical characteristics of Block IV photovoltaic solar-cell modules that have been tested by JPL are described. Such module characteristics as power output, nominal operating voltage, current-voltage characteristics, nominal operating cell temperature, and dimensions are tabulated. The limits of the environmental and other stress tests to which the modules are subjected are briefly described. Potential users of modules will find this listing helpful in selecting modules for use in arrays or alone.

61066 **(DOE/JPL—1012-77) Photovoltaic module encapsulation design and materials selection: Volume I (abridged).** Cuddihy, E. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Sep 1982. Contract AI01-76ET20356. 38p. (JPL-PUBL—82-81). NTIS, PC A03/MF A01. Order Number DE83000159.

The basic encapsulation systems for photovoltaic modules, their purposes and requirements, and the characteristics of the most promising candidate systems and materials, as identified and evaluated by the Flat-Plate Solar Array Project, are presented.

61067 **(DOE/JPL—1012-78) System for measuring thermal-activation energy levels in silicon by thermally stimulated capacitance.** Cockrum, R.H. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Sep 1982. Contract AI01-76ET20356. 40p. (JPL-PUBL—82-82). NTIS, PC A03/MF A01. Order Number DE83000455.

One method being used to determine energy levels and electrical activity of impurities in silicon is described. The method is called Capacitance Transient Spectroscopy (CTS). It can be classified into three basic categories: the thermally stimulated capacitance method (TSCAP), the voltage-stimulated capacitance method (VSCAP), and the light-stimulated capacitance method (LSCAP); the first two categories are discussed. From the total change in capacitance and the time constant of the capacitance response emission rates, energy levels, and trap concentrations can be determined. A major advantage of using CTS is its ability to detect the presence of electrically active impurities that are invisible to other techniques, such as Zeeman effect atomic absorption, and the ability to detect more than one electrically active impurity in a sample. Examples of detection of majority and minority carrier traps from gold donor and acceptor centers in silicon using the capacitance transient spectrometer are given to illustrate the method and its sensitivity. Experimental examples are given to illustrate the trap parameters that can be determined from capacitance transients, and the experimental test procedure and equipment used are described.

61068 **(DOE/RA/50387—T1) Fermentation alcohol from upstate New York cheese whey permeate: a technical/economic analysis.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1981. Contract FG07-80RA50387. 163p. NTIS, PC A08/MF A01. Order Number DE82021930.

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The results of a venture analysis study are presented, involving building a freestanding alcohol fermentation plant utilizing whey permeate from the six major cheese producers in upstate New York. Alternative Concepts for Energy, ACE, jointly owned by three New England distributors of gasoline and other fuels, would produce the alcohol for use as a gasoline additive. The distillers dried solubles (DDS) resulting as a by-product would be sold primarily to local mills for blending into feed for the dairy, poultry and pet markets.

61069 **(EUR—7015-FR) Method of making photovoltaic materials by chemical spray pulverization. Final report.** Savelli, M.; Lahaye, J.; Vedel, J. (Montpellier-2 Univ., 34 (France); Universite du Haut-Rhin, Mulhouse (France); Ecole Nationale Superieure de Chimie, 75 - Paris (France)). 1982. 64p. (In French). European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037.

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Experimental method, equipment and results are given for studies of solvent vectors for preparing Cu_2S coats by chemical pulverization, physico-chemical studies of the chemical pulverization method, and the formation and description of fine Cds and SnO_2 layers on various bases. Tabulated data are given on the electrical and optical properties of the layers with respect to their eventual use as solar cells. 31 references.

61070 **(EUR—7555-FR) Evaluation of the potential use of territory for solar energy based on pedoclimatic and topographic criteria and the crop productivity of prairies and forests - the case of France.** Meriaux, S. (Institut National de Recherches Agronomiques (INRA), 75 - Paris (France)). 1981. 68p. (In French). Commission of the European Communities, Directorate-General for Information Market and Innovation, Jean Monnet Building, Luxembourg.

A study is made of the forestry potential production of France on a scale of less than 1/1,000,000, and an identification is made of the most important promising regions using cartographic parameters on a scale of 1/100,000 to 1/250,000. Tabulated data are presented on sunlight, topography and climate with respect to the potential of solar energy, the cultivation of sugarbeet, and irrigation requirements. Global solar radiation as well as regional precipitation charts are also presented. Appendices include mathematical derivations for the automatic calculation of terrain inclines. 16 references, 26 figures.

61071 **(EUR—7557-FR) Production of grain cereals as a source of combustible and associated products.** Stengel, P.; Monnier, G.; Muller, J.C.; Remy, J.C; Guerif, J.; Tauzin, J.; Juste, G. (Institut National de Recherches Agronomiques (INRA), 75 - Paris (France)). 1981. 53p. (In French). CEC, Information Market and Innovation, Luxembourg.

Results are given for five studies which include the simulation of organic matter content evolution in the upper layers of soil as a function of straw restitution level and cultural practices, the influence of nitrogen fertilizers on the kinetics of straw decomposition, effect of straw on mechanical properties of soils, effect of intermediate substances resulting from corn stalk decomposition on zinc availability, and the fertilizing value of ashes produced in straw furnaces. Tabulated data are presented on the chemical com-

position of soils, soil production of water soluble carbon, the effect of different fertilization treatment on the yield and mineral composition of maize and ray grass. 5 references, 19 tables.

61072 **(EUR—7559-FR) Production of mechanical energy by the gasification of straw. Final report.** Lucas, J.; Molle, J.F. (Centre National d'Etudes et d'Experimentation de Machinisme Agricole, Antony (France)). 1981. 64p. (In French). European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037.

A description is given of experimental technique, apparatus and results from studies of the physical-chemical parameters of gasification, the effect of temperature on the velocity of straw gasification, reaction rates of vegetable matter gasification at various temperatures. Also presented are diagrams and illustrations of new vegetable matter gasification equipment. 4 references, 10 figures, 7 tables.

61073 **(EUR—7688-EN) Multilayer models of photosynthetic membranes. Final report.** Brocklehurst, J.R.; Flanagan, M.T. (Standard Telecommunication Labs. Ltd., Harlow (UK)). 1982. 135p. European Community Information Service, 2100 M Street, N.W., Suite 707, Washington, DC 20037.

The primary aim of this project has been to build an artificial membrane in which is incorporated, in a functional state, the protein bacteriorhodopsin responsible for generating an electrical potential difference across the membrane of the photosynthetic bacterium, halobacterium halobium, and to investigate the use of this artificial system as the basis of a solar cell. the bacteriorhodopsin has been incorporated into Langmuir-Blodgett multilayers. If ths supporting filter is then illuminated, a potential difference is generated between the two compartments. The lipid in the filter appears to act as a charge carrier for protons, the charge species that forms the electrochemical gradient generated by the bacteriorhodopsin when this molecule absorbs light. The internal resistances of such solar cells were determined and found to be so high that the cells could not be seriously considered as competitors with classical semiconductor cells. Multilayerswere deposited onto filters in which ion carriers that make the filters permeable to sodium ions had been dissolved in the paraffin. The photovoltage obtained indicated that protons transferred from one side of the filter to the other by the action of the bacteriorhodopsin were bing exchanged for sodium ions. A secondary aim of the project has been to examine the possibility of depositing mixed multilayers of a dye and a long chain quinone onto a semiconductor surface. A sensitizing multilayer has been prepared and the mobility of long chain quinones within the layers is high enough to warrant further research. However, it was found that, with the dyes and quinones used, quenched complexes were formed which would not act as sensitizers.

61074 **(IDO—10104) Results of the feasibility studies awarded under PL 96-126 and PL 96-304 for alcohol fuel production. Final report.** Hosking, R.W.; Anderson, J.V.; Jones, K.W.; Plaster, D.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 1 Mar 1982. Contract AC07-76ID01570. 110p. NTIS, PC A06/MF A01. Order Number DE82015410.

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The results from the feasibility study grants are summarized. The grants were to allow assessment of the technical and economic feasibility of construction and operation of commercial-scale alcohol fuel production facilities. Summarized are the process designs, financial and economic analyses, marketing analyses, and the environmental assessments. Use of current technology was declared to be adequate; no patents evolved from the studies. Suitable sites, served by transportation and utilities were located. Feedstock, energy sources, and raw materials were determined to be available. Environmental guidelines were found to be attainable and socioeconomic impacts and public acceptance of the projects were reported. Most of the proposed plants were declared to be economically feasible with profitability increasing with plant size. Financing was reported constrained by premium interest rates, an insecure ethanol market, and financial institution requirements for loan guarantees or high-equality loans.

61075 **(LBL—14794) Investigation of intercalated compounds for photoelectrochemical energy storage. Final report, February 23, 1981-February 22, 1982.** Rauh, R.D. (EIC Labs., Inc., Newton, MA (USA)). Jul 1982. Contract AC03-76SF00098. 52p. NTIS, PC A04/MF A01. Order Number DE83000543.

Layered chalcogenides of general formula MX_2 were investigated for the storage of electrical energy generated by photoelectrochemical solar cells. These storage materials can be highly economical and have excellent volumetric energy densities allowing direct incorporation into flat plate photovoltaic modules. Two approaches were evaluated: (1) intercalation electrodes such as Cu/sub x/TiS_2 which can be charged by a separated regenerative photoelectrochemical cell; (2) active photointercalation/photodeintercalation cells in which the storage step is effected directly by irradiating a layered semiconducting photoelectrode.

61076 **(NASA-CR—163470) Silicon production process evaluations.** (Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1981. 18p. NTIS, PC A02/MF A01.

Chemical engineering analysis of the HSC process (Hemlock Semiconductor Corporation) for producing silicon from dichlorosilane in a 1,000 MT/yr plant was continued. Progress and status for the chemical engineering analysis of the HSC process are reported for the primary process design engineering activities: base case conditions (85%), reaction chemistry (85%), process flow diagram (60%), material balance (60%), energy balance (30%), property data (30%), equipment design (20%) and major equipment list (10%). Engineering design of the initial distillation column (D-01, stripper column) in the process was initiated. The function of the distillation column is to remove volatile gases (such as hydrogen and nitrogen) which are dissolved in liquid chlorosilanes. Initial specifications and results for the distillation column design are reported including the variation of tray requirements (equilibrium stages) with reflux ratio for the distillation.

61077 **(NASA-CR—163471) Efficient structures for geosynchronous spacecraft solar arrays. Phase 1, 2 and 3. Final report.** Adams, L.R.; Hedgepeth, J.M. (Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1981. 102p. NTIS, PC A06/MF A01.

Structural concepts for deploying and supporting lightweight solar-array blankets for geosynchronous electrical power are evaluated. It is recommended that the STACBEAM solar-array system should be the object of further study and detailed evaluation. The STACBEAM system provides high stiffness at low mass, and with the use of a low mass deployment mechanism, full structural properties can be maintained throughout deployment. The stowed volume of the STACBEAM is acceptably small, and its linear deployment characteristic allows periodic attachments to the solar-array blanket to be established in the stowed configuration and maintained during deployment.

61078 **(NASA-CR—163473) Processing experiments on non-Czochralski silicon sheet. Final report.** Pryor, R.A.; Grenon, L.A.; Sakiotis, N.G.; Pastirik, E.M.; Sparks, T.O.; Legge, R.N. (Motorola, Inc., Phoenix, AZ (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1981. 221p. NTIS, PC A10/MF A01.

A program is described which supports and promotes the development of processing techniques which may be successfully and cost-effectively applied to low-cost sheets for solar cell fabrication. Results are reported in the areas of process technology, cell design, cell metallization, and production cost simulation.

61079 **(NASA-CR—163474) Development and fabrication of a solar cell junction processing system.** Bunker, S. (Spire Corp., Bedford, MA (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Oct 1981. 30p. NTIS, PC A03/MF A01.

A solar cell junction processing system was developed and fabricated. A pulsed electron beam for the four inch wafers is being assembled and tested, wafers were successfully pulsed, and solar cells fabricated. Assembly of the transport locks is completed. The transport was operated successfully but not with sufficient reproducibility. An experiment test facility to examine potential scaleup

problems associated with the proposed ion implanter design was constructed and operated. Cells were implanted and found to have efficiency identical to the normal Spire implant process.

61080 (NASA-CR—163475) Development of a polysilicon process based on chemical vapor deposition (phase 1). Mccormick, J.; Arvidson, A.; Sawyer, D.; Plahutnik, F. (Jet Propulsion Lab., Pasadena, CA (USA)). Jun 1981. 51p. NTIS, PC A04/MF A01.

A dichlorosilane-based reductive chemical vapor deposition (CVD) process demonstrated is capable of producing, at low cost, high quality polycrystalline silicon. Testing of decomposition reactor heat shields to insure that the shield provides adequate personnel protection assuming a worst case explosion was completed. Minor modifications to a production reactor heat shield provided adequate heat shield integrity. Construction of the redesigned PDU (Process Development Unit) to accommodate all safety related information proceeded on schedule. Structural steel work was completed as is the piping and instrumentation design work. Major pieces of process equipment were received and positioned in the support structure and all transfer piping and conduits to the PDU were installed. Construction was completed on a feed system for supplying DCS to an intermediate sized reactor. The feed system was successfully interfaced with a reactor equipped with a modified heat shield. Reactor checkout was completed.

61081 (NASA-CR—163476) Silicon-on ceramic process: silicon sheet growth and device development for the large-area silicon sheet task of the low-cost solar array project. Final report. Grung, B.L.; Heaps, J.D.; Schmit, F.M.; Schuldt, S.B.; Zook, J.D. (Jet Propulsion Lab., Pasadena, CA (USA)). Mar 1981. 239p. NTIS, PC A11/MF A01.

The technical feasibility of producing solar-cell-quality sheet silicon to meet the Department of Energy (DOE) 1986 overall price goal of $0.70/watt was investigated. With the silicon-on-ceramic (SOC) approach, a low-cost ceramic substrate is coated with large-grain polycrystalline silicon by unidirectional solidification of molten silicon. This effort was divided into several areas of investigation in order to most efficiently meet the goals of the program. These areas include: (1) dip-coating (2) continuous coating designated SCIM-coating, and acronym for Silicon Coating by an Inverted Meniscus (SCIM) (3) material characterization (4) cell fabrication and evaluation and (5) theoretical analysis. Both coating approaches were successful in producing thin layers of large grain, solar-cell-quality silicon. The dip-coating approach was initially investigated and considerable effort was given to this technique. The SCIM technique was adopted because of its scale-up potential and its capability to produce more conventiently large areas of SOC.

61082 (NASA-CR—165081) Study of the photovoltaic effect in thin film barium titanate. Grannemann, W.W.; Dharmadhikari, V.S. (New Mexico Univ., Albuquerque (USA)). Jan 1982. 24p. NTIS, PC A02/MF A01.

Ferroelectric films of barium titanate were synthesized on silicon and quartz substrates, and the photoelectric effect in the structure consisting of metal deposited ferroelectric barium titanate film silicon was studied. A photovoltage with polarity that depends on the direction of the remanent polarization was observed. The deposition of BaTiO3 on silicon and fused quartz substrates was accomplished by an rf sputtering technique. A series of experiments to study the growth of ferroelectric BaTiO3 films on single crystal silicon and fused quartz substrates were conducted. The ferroelectric character in these films was found on the basis of evidence from the polarization electric field hysteresis loops, capacitance voltage and capacitance temperature techniques and from X-ray diffraction studies.

61083 (NASA-CR—168442) Results of the 1981 NASA/JPL Balloon Flight Solar Cell Calibration Program. Seaman, C.H.; Weiss, R.S. (Jet Propulsion Lab., Pasadena, CA (USA)). Jan 1982. 16p. NTIS, PC A02/MF A01.

The calibration of the direct conversion of solar energy through use of solar cells at high altitudes by balloon flight is reported. Twenty seven modules were carried to an altitude of 35.4 kilometers. Silicon cells are stable for long periods of time and can be used as standards. It is demonstrated that the cell mounting cavity may be either black or white with equal validity in setting solar simulators. The calibrated cells can be used as reference standards in simulator testing of cells and arrays.

61084 (NP—2902755) Energy from the biomass. Report No. 5. (Watt Committee on Energy, London (UK)). Jun 1979. 76p. Watt Committee on Energy Ltd., 1 Birdcage Walk, London SW1H 9JJ England.

Seven papers are included. A separate abstract was prepared for each one.

61085 (SAND—81-7194) Solar-cell testing and evaluation. Stefanakos, E.K.; Collis, W.J. (Sandia National Labs., Albuquerque, NM (USA); North Carolina Agricultural and Technical State Univ., Greensboro (USA). Dept. of Electrical Engineering). Apr 1982. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01. Order Number DE82016179.

A two year study of the degradation effects in AlGaAs/GaAs solar cells is described. Illuminated current-voltage measurements were made during temperature and humidity cycling and time dependent degradation measurements were recorded.

61086 (SERI/PR—1202-1-T5) Photoelectronic properties of zinc phosphide crystals, films, and heterojunctions. Quarterly progress report No. 13 for the period April 1-June 30, 1982. Bube, R.H. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). 1982. Contract AC02-77CH00178. 122p. NTIS, PC A06/MF A01. Order Number DE82019282.

Portions of document are illegible.

The research on zinc phosphides is summarized and includes: Zn_3P_2 materials preparation; electrical characterization of Zn_3P_2 crystals; characterization by low temperature photoluminescence, photoconductivity, Auger electron spectroscopy, and transmission electron microscopy; investigation of Zn_3P_2 based devices; and Zn_3P_2 films grown by close spaced vapor transport. An approach to future research on Zn_3P_2 is summarized and includes: chemical vapor transport growth with $ZnCl_2$, $ZnBr_2$, and ZnI_2; an investigation of defect structure vs deviations from stoichiometry; growth and properties of (Zn_3P_2)/sub x/(Cd_3P_2)/sub 1-x/ solid solutions; surface investigations on Zn_3P_2; reactive metal junctions; and MIS structures on Zn_3P_2. Appended are two manuscripts, one on transport mechanisms for mg/Zn_3P_2 junctions and the other on properties of Zn_3P_2 crystals and devices. (LEW)

61087 (SERI/PR—9100-1-T2) Exploratory development of thin-film polycrystalline silicon photovoltaic devices. Molybdenum TESS process for continued shear separation of microcrystalline silicon films. Topical report No. 2. Sarma, K.R.; Rice, M.J. Jr. (Solar Energy Research Inst., Golden, CO (USA); Motorola, Inc., Phoenix, AZ (USA)). Sep 1981. Contract AC02-77CH00178. 36p. NTIS, PC A03/MF A01. Order Number DE82008026.

Several techniques were investigated for resurfacing molybdenum sheets so that they may be reused many times as temporary substrates for the deposition of thin silicon microcrystalline ribbons by the TESS (Thermal Expansion Shear Separation) process. Wet chemical etching was found to leave too nonuniform a surface. Plasma etching was too slow for economical consideration. Surface grinding working well, but was still projected to be too expensive to meet the long range SERI goals. Electropolishing was determined to be both practical and economical.

61088 (SERI/PR—9330-1-T5) Preparation and properties of evaporated CdTe films compared with single-crystal CdTe. Progress report No. 5, November 1, 1981-January 31, 1982. Bube, R.H. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). 1982. Contract AC02-77CH00178. 18p. NTIS, PC A02/MF A01. Order Number DE82011043.

The hot-wall vacuum evaporator system has been put into use with successful deposition of seven thin films of n-type CdTe on glass. Microprobe analysis indicated that the films were stoichiometric CdTe. Optical transmission showed a well-defined absorption edge. Film resistivities on glass were reduced from 1.7×10^{8}

ohm-cm, to 6 x 10^4 ohm-cm by In doping; film resistivities under AM1.5 illumination are 2.0 x 10^4 and 5 x 10^2 ohm-cm, respectively compared to the dark values given above. Temperature dependence of the dark conductivity of the undoped CdTe film indicates an activation energy of 0.79 eV; in the light the activation energy was reduced to 0.1 eV. The high dark resistivity and activation energy indicate high intergrain potential barriers, which could produce the high resistivities observed even with fairly high free electron densities in the grains. Comparison will be sought between these results and those found for films deposited epitaxially on single crystal substrates. A detailed summary of absorption constant vs wavelength data for CdTe has been assembled for both single crystal and thin film materials. The absorption constant for thin film material appears to vary from 2 x 10^4 cm^{-1} at 8000A to 10^5 cm^{-1} at 5000A; single crystal values may be slightly higher. EBIC and light scanning techniques are being developed for characterizing grain boundary effects in bicrystals, and to evaluate the effects of passivation techniques. Defect densities at a grain boundary in a p-type bicrystal were found to range from 2 x 10^{12} to 8 x 10^{12} $cm^{-2}eV^{-1}$, using data derived from the J-V dependence of the grain boundary.

61089 **(SERI/TP—213-1618) RF sputtering of low-resistivity CdS thin films.** Kwietniak, M.; Warminski, T.; Beaulieu, R.; Loferski, J.J.; Ireland, P.J.; Kazmerski, L.L. (Solar Energy Research Inst., Golden, CO (USA); Brown Univ., Providence, RI (USA). Div. of Engineering). Jun 1982. Contract AC02-77CH00178. 5p. (CONF-820508—4). NTIS, PC A02/MF A01. Order Number DE82020507.

From Spring meeting of the Electrochemical Society; Montreal, Canada (9 May 1982).

The compositional, structural and electrical properties of low-resistivity rf-sputtered CdS thin films are investigated. The low-resistivity (< 1 Ω-cm) results from preparing sulfur-deficient CdS targets by heating in pure hydrogen. The films are characterized by SEM, EDAX, EMPA and SAM for compositional and structural properties. Four point and thermal probes are used in the electrical characterization.

61090 **(SERI/TP—234-1681) Thermochemical energy storage and transport.** Nix, R.G. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1982. Contract AC02-77CH00178. 6p. (CONF-820827—3). NTIS, PC A02/MF A01. Order Number DE82020069.

From Energy storage contractors review meeting; Arlington, VA, USA (23 Aug 1982).

Feasibility studies of thermochemical energy storage and transport (TEST) are described. Cases studied include a large central receiver heat utility and a small industrial process heat application with distributed parabolic dish solar collectors. TEST does not appear to be generally cost-effective; however, there are special cases of cost-effectiveness. The overall recommendation is that research on thermochemical processes should emphasize the manufacture of renewable fuels using solar energy and the search for more cost-effective TEST systems.

61091 **(SERI/TR—09380-1) Design and operation of industrial boilers fired with wood and bark residue fuels.** Junge, D.C. (Oregon State Univ., Corvallis (USA)). Aug 1982. Contract AC02-77CH00178. 214p. NTIS, PC A10/MF A01. Order Number DE82022031.

Most of the technical reference literature concerning the design and operation of industrial wood and bark-fired boilers and supporting facilities is out of date. This publication updates existing information and includes extensive research and development data that was generated at Oregon State University. Topics covered include the state of wood combustion technology; the basic characteristics of wood fuels; the principles of wood combustion and parameters that influence combustion; fuel receiving preparation, and storage; and pollution control.

61092 **(TVA/OACD—82/16) Programmatic environmental overview. Biomass fuels program.** Roetheli, J.C.; Betson, R.P.; Bohac, C.E. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). Jul 1982. 24p. NTIS, PC A02/MF A01. Order Number DE82906065.

Some potential environmental issues related to use of renewable biomass resources as fuels are identified. Possible management strategies for eliminating or holding the consequences within manageable bounds are suggested. Production impacts are discussed as follows: soil erosion, water quality, soil/stand productivity, and aesthetics, wildlife, and related areas. Conversion and combustion impacts on air quality, water quality, and solid wastes are described.

61093 **(UCID—19500) Overview of solar-energy systems for electricity production: comparison by cost and efficiency.** Whitehead, J.C. (Lawrence Livermore National Lab., CA (USA)). 23 Jul 1982. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01. Order Number DE82022516.

Pertinent data are tabulated for eight solar energy conversion methods: algal biomass, agricultural biomass, biophotolysis, salt gradient solar pond, ocean thermal energy conversion, concentrated solar thermal power, silicon solar cells, and propeller wind turbines. Justifications are given for the table entries. For each system, the theoretical maximum efficiencies of the energy conversion steps are compared with actual obtained values, and attempts are made to explain the differences. (LEW)

61094 **High-efficiency organometallic vapor phase epitaxy AlGaAs/GaAs monolithic cascade solar cell using metal interconnects.** Ludowise, M.J.; LaRue, R.A.; Borden, P.G.; Gregory, P.E.; Dietze, W.T. (Varian Associates, Incorporated, Corporate Solid State Laboratory, Palo Alto, California 94303). *Applied Physics Letters;* **41**: No. 6, 550-552(15 Sep 1982).

A two-junction solar cell has been fabricated using an Al/sub 0.30/Ga/sub 0.70/As (1.82 eV) tap cell and a GaAs (1.43 eV) bottom cell. A processed metal interconnect is used to connect the two cells together in series. An efficiency of 21.5% at 980 mW/cm^2 has been measured in a solar simulator with an open circuit voltage of 2.35 V, a short circuit current of 118.6 mA/cm^2, and a fill factor of 0.76. An efficiency of 22% has been measured under 130 AM3 sun in a solar tracking concentrator. Organometallic vapor phase epitaxy is used to grow the entire nine-layer device.

61095 **Efficiency of light-energy conversion in photogalvanic cells and water cleavage systems.** Dung, M.H.; Kozak, J.J. (Department of Chemistry and Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). *Journal of Chemical Physics;* **77**: No. 6, 3246-3257(15 Sep 1982).

In this paper we assess the thermodynamic efficiency of models for a well-known photogalvanic cell and a recently developed water cleavage system in order to determine, for comparable light-flux conditions, their relative effectiveness as light-energy conversion devices. The photogalvanic cell considered is the $Ru(bipy)_3^{+2}/Ru(bipy)_3^{+3}$—$Fe^{+2}/Fe^{+3}$ system and we base our calculations on the experimental work of Creutz and Sutin, and Lin and Sutin, and the theoretical analysis of Albery and Archer. The cyclic water cleavage system considered is the $Ru(bipy)_3^{+2}/Ru(bipy)_3^{+3}$—$MV^{+1}/MV^{+2}$ system (using a dispersed metal/metal oxide catalyst) discovered by Kalyanasundaram and Graetzel, and our calculations are based on their experimental work and the recent stability analysis of this system reported by Dung and Kozak. Although superficially different, the analysis draws attention to the common (photochemical, electrochemical, and mathematical) features of these two systems and, where possible, this correspondence is stressed and implemented in our simulations. Although other examples of each type of device are known, for this pair of systems (as described by the models presented herein) we find that the efficiency of conversion of light energy into electrical energy via a photogalvanic cell is similar to the efficiency of conversion of light energy into chemical energy via the (cyclic) water cleavage system, if the concentration of the dispersed metal/metal oxide catalyst in the system is $<10^{-4}$ M. However, one finds a pronounced increase in the efficiency of the water cleavage system (under the same light-flux conditions) when the concentration of catalyst is increased, and this enhancement is quantified in our simulations. Alternatively, simulations also show that the efficiency of the photogalvanic system can improve markedly upon suppressing the back reaction between Ru(III) and Fe(II).

61096 **Simulated water budgets for an irrigated sycamore phytomass farm.** Crandall, D.A.; Luxmoore, R.J. (Oak Ridge National Lab., TN). *Forest Science;* **28**: No. 1, 17-30(Mar 1982).

A simulated sycamore (Platanus occidentalis L.) phytomass farm on a coastal plain site in South Carolina was analyzed with a soil-plant-water budget model to identify and quantify water-related impacts. Input data for the model were obtained from the literature, from personal communication, or from assumed values based on available surrogate data. A 13-year management scenario included the clearing of a coniferous forest followed by the establishment and growth of intensive culture sycamore. A phytomass harvest was assumed after the 7th year followed by 6 years of sycamore coppice regrowth. A baseline case without irrigation and six irrigation cases (maintaining soil water potential at or above -4, -2, -1, -0.5, -0.3, and -0.1 bars, respectively) were simulated. Output from these water budget simulations included surface runoff, soil drainage, irrigation requirement, and leaf water potential. No surface runoff was estimated in any of the simulation cases, indicating negligible soil erosion potential. Soil drainage showed a tenfold increase between the initial coniferous forest and the average drainage for the phytomass farm. A large portion (74-100 percent) of the irrigation applications contributed to additional drainage.

61097 **Gallium arsenide photovoltaic dense array for concentrator applications.** Wiczer, J.J. (Sandia Laboratories, Albuquerque, NM); Cape, J.A. (Rockwell International Electronics Research Center, Thousand Oaks, CA). pp 114-118 of Role of electro-optics in photovoltaic energy conversion. Deb, S.K. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1980). Contract AC04-76DP00789.

From International symposium of the Society of Photo-Optical Instrumentation Engineers; San Diego, CA, USA (28 Jul 1980).

This paper reports the design, fabrication and testing of a dense array consisting of 16 overlapped linear modules, each containing 16 contiguous 1 cm x 1.25 cm GaAs concentrator cells in a row. The overlapping is done so that only active cell area is presented to the concentrated sunlight. The array presents a frontal area of 320 sq cm, and is designed to yield a system output of about 230 volts at 20-25 amps and 1000 suns. The results of tests carried out at concentrations up to 1500 suns and temperatures to 185 C will be presented.

61098 **Prospect of a biological-photochemical approach for the utilisation of solar energy.** Hall, D.O.; Coombs, J. *Report - Watt Committee on Energy;* No. 5, 1-15(Jun 1979). (NP—2902755).

An assessment of the possible utilization of the direct biological conversion of solar energy is presented. The available light energy, energy used by plants, present photosynthetic production, carbon dioxide in the atmosphere, carbon dioxide assimilation, conversion technology, and present and potential crop productivity are analyzed and presented graphically and in tabulated form. Future possibilities which are discussed are algal systems, plant selection, and synthetic systems. Hydrogen production and economics are also discussed. (MJF)

61099 **Fuel crops: an assessment of the UK potential.** Spedding, C.R.W.; Bather, D.M.; Walsingham, J.M. *Report - Watt Committee on Energy;* No. 5, 17-24(Jun 1979). (NP—2902755).

An assessment of land use for plant production and an examination of this potential for contributing to UK fuel supplies are presented. In the short-term, UK can use plant residues from agriculture and forestry; in the medium-term, UK could use land currently unused for all or part of the year for fuel crops; and in the long term, UK could use land currently used for other purposes. For agriculture, the short-term plan could provide up to 0.9% of UK's consumption; the medium-term, 4%; and the long-term, up to 41%. For natural vegetation long-term, 4.4% of UK consumption could be provided. The potential of forests, wastelands, and aquatic vegetation are also discussed. (MJF)

61100 **Energy from biomass by anaerobic digestion.** Stafford, D.A.; Horton, R.; Hawkes, D. *Report - Watt Committee on Energy;* No. 5, 25-35(Jun 1979). (NP—2902755).

A technological assessment of anaerobic digestion of biomass is presented. The microbiology and biochemistry of anaerobic digestion are briefly outlined. Types of digesters are discussed along with their performance parameters, design, and operation. The materials available for digestion, i.e. municipal refuse, cattle waste, poultry wastes, and pig wastes, are also discussed as well as the cost of this energy. (MJF)

61101 **Biogas production: agricultural wastes.** Hobson, P.N. *Report - Watt Committee on Energy;* No. 5, 37-44(Jun 1979). (NP—2902755).

A brief survey of research and development in the field of farm-waste digesters is presented. The gas production from various wastes, i.e. piggery wastes, cattle wastes, and poultry wastes, obtained from experiments with pilot-plants and small farm-scale digesters which are run at mesophilic temperatures is discussed. The digester tank design, input and output design, digester stirring, gas storage, digester heating, gas usage, and safety of farm-scale digesters are discussed. (MJF)

61102 **Department of Energy: solar biological programme: biofuels.** King, G.H. *Report - Watt Committee on Energy;* No. 5, 69-75(Jun 1979). (NP—2902755).

The establishment and first year findings of assessment studies conducted by DOE of the UK on biofuels are discussed. The program was established in October 1977 and its objectives are: (1) to determine the contribution that biofuels might make to the UK's energy supply during the next 50 years; (2) to simplify the existing complex set of possible fuel production routes; 3) to define the RD & D required to bring the more promising routes to commercial viability. The projects embraced three broad technical areas: residues, energy crops, and conversion technology. (MJF)

61103 **(DOE/ET/20434—1) Oxide semiconductor silicon heterojunction cells. Final progress report, September 17, 1976-November 16, 1977.** Dubow, J.B. (Colorado State Univ., Fort Collins (USA)). [nd]. Contract AC03-76ET20434. 147p. NTIS, PC A07/MF A01. Order Number DE82021160.

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A 12.2% efficient solar cell has been fabricated by the ion-beam sputter deposition of degenerate n-type indium tin oxide (ITO) on p-type 1-2 ohm-cm silicon. The model chosen for these cells is an MIS/SIS structure. Indium tin oxide (ITO) transparent thin films on p-type silicon heterojunction photodiodes have been analyzed. The dark current of these non-idealized diodes, which is a function of temperature, is found to be related to tunneling mechanism. Capacitance-voltage analysis shows there is a relatively high trap concentration in the interfacial layer. Measurements of current-voltage characteristics and spectral response are studied by using a 150W xenon arc lamp with infrared filter as a source. Temperature effects on photodiode parameters are investigated from 200°K to 400°K. Results are closely related to the properties of p-n junction silicon photodiodes. The Auger technique is shown to be useful in quality control of cells since it was used to monitor contamination within the solar cell. Contamination severely degrades the solar cell performance and Auger helped to identify its sources in order that contamination could be eliminated. Detection of SiO_2 at the ITO/Si interface was accomplished by comparing the Si LMM lines of ultrathin Si oxides to those taken while sputter profiling through the ITO/Si interface. SiO_2 was found at the interface of all cells examined and there seems to be a correlation between the oxide thickness and the solar cell performance. Thus efficient ITO/Si devices behave as induced junction (inversion layer) SIS diodes.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 61035, 61036, 61055, 61056, 61059

61104 **(DOE/ET/20279—191) Development of a dc-to-ac inverter based on waveshaping.** Cox, C.H. III; Landsman, E.E.; Rasmussen, N.E. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.; American Power Conversion Corp., Burlington, MA (USA)). Aug 1982. Contract AC02-76ET20279. 54p. NTIS, PC A04/MF A01. Order Number DE83000660.

A new topology for utility-interactive, dc-ac inverters is explored. The approach is presently limited by available devices to the single-phase, 2 to 10 kW power levels typical of residential photovoltaic applications. The approach combines two of the three basic inverter operations - waveshaping and regulation - in a single dc-dc converter stage. The output of this stage is a full-wave rectified (unipolar) sine wave. An inversion stage follows, performing the third basic inverter operation. The output is a current sine wave. This approach features unity power factor and less than 2% total current harmonic distortion. A 1-kW prototype was constructed, using a buck (down) converter for the dc-dc stage switching at approximately 20 kHz. Efficiency was generally above 90% with a peak efficiency of 94%. A cost breakdown of the prototype indicated the inverter could be built to meet the DOE cost goals for this class of inverter.

61105 **(DOE/ET/20279—205) Evaluation of recent residential inverters.** Nichols, B.E. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Jun 1982. Contract AC02-76ET20279. 23p. NTIS, PC A02/MF A01. Order Number DE82022237.

Seven residential utility-interactive inverters for photovoltaic power systems have been evaluated at MIT Laboratory and at the Northeast Residential Experiment Station (NE RES). Two, a Windworks Gemini and an Abacus Sunverter, have been reported on previously. Reviewed here are five other inverters: Windworks Gemini 8-kW (dc) model with an ac filter to improve the output current waveform and power factor; Acheval Wind Electronics 10-kW (ac) model, Helionetics 6-kW (dc) model; and American Power Conversion 2-kW and 4-kW (ac) models. Input and output power, power factor, current waveform distortion, audio noise and radio frequency interference measurements were made at the NE RES and the results are presented.

61106 **(DOE/ET/20279—210) Florida Solar Energy Center: final report on innovative photovoltaic application for residences experiment.** Atmaram, G.H.; Litka, A.H. (Florida Solar Energy Center, Cape Canaveral (USA)). Jun 1982. Contract AC02-76ET20279. 108p. NTIS, PC A06/MF A01. Order Number DE83000399.

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Presented are the description and operational results on the performance of the 5 kilowatt peak photovoltaic residential system at the Florida Solar Energy Center (FSEC). The primary objective of this report is to present one year's (April 1981 to March 1982) operational performance results on the FSEC photovoltaic residential system. For the sake of completeness, the description of the residence, photovoltaic system, instrumentation and data collection procedure is included. The performance of the photovoltaic array, inverters and total photovoltaic system is detailed. The instrumentation upgrading, system diagnostics, and any failures or system downtime are described.

61107 **(DOE/ET/20279—217) Design and fabrication of a prototype system for photovoltaic residences in the northeastern United States. Final report.** Millner, A.R. (TriSolar Corp., Bedford, MA (USA)). Aug 1982. Contract AC02-76ET20279. 81p. NTIS, PC A05/MF A01. Order Number DE82022236.

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The intention of the project was to develop plans for an energy-efficient residence for the Northeastern region of the country, and to design into it a roof-mounted photovoltaic (PV) solar electric power system which would allow two-way power flow between the utility grid and the house. A full scale working prototype of the PV system was built to evaluate the performance of that system for one year. Described are the residence design, the prototype description, the construction and the fabrication history through the first year of operation.

61108 **(EPRI-AP—2544) Photovoltaic field-test performance assessment. Technology status report Number 1.** Inglis, D.J. (Boeing Computer Services Co., Tukwila, WA (USA). Energy Technology Applications Div.). Aug 1982. 100p. NTIS, PC A05/MF A01. Order Number DE82906455.

Performance descriptions are provided for four flat plate array photovoltaic field tests operated during 1981. The systems range in size from 18 kW to 100 kW. Three of them include dc to ac inverters; one uses dc directly. All of the sites have extensive instrumentation; readings are generally available every 10 minutes. Overall system conversion efficiencies for the newest systems are in the range 5.0 to 6.5 percent. Clear day capacity factors can be as high as 25 to 30%. On partly cloudy days capacity factors are considerably less. Clear day energy output from the arrays remains relatively constant throughout the year. The power conditioning subsystems are reliable and efficient.

61109 **(NASA-CR—165269) Overview study of space power technologies for the advanced energetics program.** Taussig, R.; Gross, S.; Millner, A.; Neugebauer, M.; Phillips, W.; Powell, J.; Schmidt, E.; Wolf, M.; Woodcock, G. (Mathematical Sciences Northwest, Inc., Bellevue, WA (USA)). Oct 1981. 341p. NTIS, PC A15/MF A01.

Space power technologies are reviewed to determine the state-of-the-art and to identify advanced or novel concepts which promise large increases in performance. The potential for incresed performance is judged relative to benchmarks based on technologies which have been flight tested. Space power technology concepts selected for their potentially high performance are prioritized in a list of R & D topical recommendations for the NASA program on Advanced Energetics. The technology categories studied are solar collection, nuclear power sources, energy conversion, energy storage, power transmission, and power processing. The emphasis is on electric power generation in space for satellite on board electric power, for electric propulsion, or for beamed power to spacecraft. Generic mission categories such as low Earth orbit missions and geosynchronous orbit missions are used to distinguish general requirements placed on the performance of power conversion technology. Each space power technology is judged on its own merits without reference to specific missions or power systems. Recommendations include 31 space power concepts which span the entire collection of technology categories studied and represent the critical technologies needed for higher power, lighter weight, more efficient power conversion in space.

61110 **(NASA-TM—58233) Satellite power system. Concept Development and Evaluation Program, Volume 6: construction and operations.** Benson, H.; Jenkins, L.M. (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). Apr 1981. 216p. NTIS, PC A10/MF A01.

The construction, operation, and maintenance requirements for a solar power satellite, including the space and ground systems, are reviewed. The basic construction guidelines are explained, and construction location options are discussed. The space construction tasks, equipment, and base configurations are discussed together with the operations required to place a solar power satellite in geosynchronous orbit. A rectenna construction technique is explained, and operation with the grid is defined. Maintenance requirements are summarized for the entire system. Key technology issues required for solar power satellite construction operations are defined.

61111 **(SAND—81-7019(Vol.2)) Study of photovoltaic residential retrofits. Volume II. Main report.** Mahone, D.E.; Temple, P.L.; Adams, J.A.; Chalmers, B.B.; Motter, A.D.; Millner, A.E. (Sandia National Labs., Albuquerque, NM (USA); T.E.A., Inc., Harrisville, NH (USA); TriSolar Corp., Bedford, MA (USA)). Apr 1982. Contract AC04-76DP00789. 267p. NTIS, PC A12/MF A01. Order Number DE82015626.

The problems and potentials for widespread residential retrofits of PV power systems are analyzed. Included are data on the existing housing stock, designs for array mounting and system electrical wiring, and economic analyses for retrofits.

61112 **(SAND—81-7080/1) Intermediate photovoltaic system application experiment operational performance report. Volume 1. For G.N. Wilcox Memorial Hospital, Kauai, Hawaii.** (Boeing Computer Services Co., Seattle, WA (USA)). Sep 1982. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01. Order Number DE83000393.

Presented are the data accumulated during January, February, and March 1982 at the intermediate photovoltaic project at G.N. Wilcox Memorial Hospital, Kauai, Hawaii. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided.

61113 **(SAND—81-7085/12) Intermediate photovoltaic system application experiment operational performance report for Lovington Square Shopping Center, Lovington, New Mexico.** (Boeing Computer Services Co., Seattle, WA (USA)). Sep 1982. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01. Order Number DE83000391.

Presented are the data accumulated during May at the intermediate photovoltaic project at Lovington Square Shopping Center, Lovington, New Mexico. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided.

61114 **(SAND—81-7089/3) Intermediate photovoltaic system application experiment operational performance report for CDC Light Manufacturing Building, San Bernardino, California.** (Sandia National Labs., Albuquerque, NM (USA); Boeing Computer Services Co., Seattle, WA (USA)). Aug 1982. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01. Order Number DE82020883.

Presented are the data accumulated during May at the intermediate photovoltaic project at the CDC Light Manufacturing Bldg., San Bernardino, California. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities not attributable to weather are provided.

61115 **Solar-powered liquid-metal MHD power systems.** Pierson, E.S. (Argonne National Laboratory, Argonne, Ill.); Fabris, G. (Argonne National Laboratory, Argonne, Ill.; Negev, University, Beersheba, Israel). *American Society of Mechanical Engineers, [Paper]*; No. 79-WA/SOL-22, 1-8(1979). Contract W-31-109-ENG-38.

The two-phase liquid-metal MHD power cycles coupled to solar collectors have potentially a higher efficiency of converting solar energy input into useful electrical power output for all collector temperatures. The MHD interaction is a volume effect, so that efficiency is essentially independent of design power level down to fractional-megawatt size, and the performance is attractive even at approximately 50 kWe size. The use of two working fluids in the energy-conversion system is advantageous in coupling the conversion cycle to solar collectors and direct-contact boilers can be used to obtain, higher conversion system temperatures. Two liquid-metal MHD systems of interest for solar collectors are presented and explained. Liquid metal MHD conversion systems appropriate to low, intermediate, and high collector temperatures are described along with initial efficiency and cost results.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 61026

61116 **(EPRI-AP—2435-SY) 1-MW(th) solar-thermal conversion full-system experiment.** Bartlett, D.H. (Boeing Engineering and Construction Co., Seattle, WA (USA)). Aug 1982. 71p. NTIS, PC A04/MF A01. Order Number DE82906454.

Progress made during the first phase effort of the Solar-Thermal Full-System Experiment is summarized. This is one of a number of projects in the Solar-Thermal Subprogram involved with the development of solar central receiver hardware and systems for future use by utilities. The main emphasis is on systems that use Brayton-Cycle (gas turbine) equipment. The project summarized involves the planning and design of a complete Brayton-Cycle solar central receiver experimental system that would include all components of a commercial-size electric utility solar power plant. The objective of the overall project is to demonstrate the technical feasibility of a complete Brayton-Cycle, solar-fossil hybrid central receiver system. Major objectives of the Phase I effort summarized are to plan and design the experiment in detail and to organize a utility Test and Operating Group that would be directly involved in the development and operation of the experiment. (LEW)

61117 **(SAND—82-0181) Beam quality and tracking-accuracy evaluation of second-generation and Barstow production heliostats.** King, D.L. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 129p. NTIS, PC A07/MF A01. Order Number DE82022224.

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The results are given of the optical performance (beam quality) and tracking accuracy evaluation of the second-generation prototype heliostats and the Barstow production heliostat. Instrumentation, analytical techniques, and performance error sources are discussed in detail. Test results are in a form that will enable full-field performance predictions, and example cases of full-field performance measurements at the CRTF are given.

61118 **(SERI/TR—214-1449) ROSET: a solar-thermal electric-power simulation user's guide.** O'Doherty, R. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1982. Contract AC02-77CH00178. 78p. NTIS, PC A05/MF A01. Order Number DE82021997.

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The report describes and explains how to use a set of computer programs (ROSET) that simulate solar thermal electric power systems. ROSET is designed to function as part of a larger package of computer models. These models can be used with most utility planning models as part of a method for determining the value of solar energy power systems to electric utilities.

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

REFER ALSO TO CITATION(S) 61147

61119 **(DOE/ET/21002—17) OTEC support services. Quarterly technical progress report No. 17, 15 May 1982-14 August 1982.** (VSE Corp., Alexandria, VA (USA)). Aug 1982. Contract AC02-78ET21002. 10p. NTIS, PC A02/MF A01. Order Number DE82021051.

Progress relative to accomplishments and relative to meetings, conferences, etc. are reported in the areas of OTEC commercialization support, program technical engineering and instrumentation analysis, technical and management services, OTEC system integration, and transmission subsystem considerations. (LEW)

61120 **(DOE/NBM—1043-Vol.1) Physical, chemical, and biological measurements off Puerto Rico.** Vargo, S.; Fanning, K.; Hopkins, T.; Michel, H.; Vargo, G.; Hartwig, E.; Jones, A. (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography; University of South Florida, St. Petersburg (USA). Dept. of Marine Science; Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences; Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 214p. NTIS, PC A10/MF A01. Order Number DE82021294.

Physical, chemical, and biological measurements were made during three quarterly sampling cruises at the PROTEC benchmark site on the southeast coast of Puerto Rico. Physical measurements at the site were expendable bathythermographs (XBT), conductivity/temperature/depth (CTD) profiles, and temperature profiles using reversing thermometers. Chemical measurements made at the site were salinity, dissolved oxygen, and nutrients (phosphate, silicate, ammonia, nitrate + nitrite, organic phosphorous, and organic

nitrogen). Biological measurements were made on phytoplankton, zooplankton, and micronekton. Both structural (biomass, species abundance, and species composition) and functional (primary production) measurements were made. Measurements indicate that the thermal resource is adequate for OTEC plant operation during all seasons. The physical, chemical, and biological measurements made at the site were generally within values reported for other tropical-subtropical regions. There was considerable seasonal and diurnal variability in the data. (LEW)

61121 **(DOE/NBM—2021316) Bioassay studies to determine OTEC's effect on phytoplankton activity.** Carmiggelt, C.J.W.; Hartwig, E.O.; Commins, M.L.; Horne, A.J. (Lawrence Berkeley Lab., CA (USA)). Sep 1982. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01. Order Number DE82021316.

The effect of artificially upwelled water (800m) on phytoplankton from 25m and 100m was simulated using five day bioassays. The results show that some enhancement of the phytoplankton populations in the receiving waters due to upwelling is likely to occur. The very small phytoplankton (< 5 um) are most important in this response. The magnitude of the biostimulation cannot be predicted from this study. Ammonia leaks, spills, and venting are probable in an operating OTEC plant. The bioassays show that additions of ammonia will produce biostimulaton only when the P/N ratio indicates nitrogen limitation. In the Hawaiian waters sampled N-limitation was not always present and varied with depth. No nitrogen fixation was detected. The magnitude of stimulation due to ammonia alone was generally less than the addition of upwelled water which is a more complete nutrient mixture.

61122 **(DOE/NBM—3000003) Current observations offshore Punta Tuna, Puerto Rico, 21 June-7 December 1980. Part A.** Frye, D.; Leavitt, K.; Whitney, A. (EG and G, Inc., Waltham, MA (USA). Environmental Consultants Div.). Aug 1981. Contract W-7405-ENG-48. 111p. NTIS, PC A06/MF A01. Order Number DE83000003.

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An oceanographic measurement program was conducted in the vicinity of a proposed ocean thermal energy conversion (OTEC) site about 20 km offshore of Punta Tuna, Puerto Rico. As part of the program, a mooring consisting of five current meters was maintained between 21 June and 7 December, 1980. The current data collected are summarized according to frequency of occurrence within 5 cm/sec speed and 15° direction intervals. Sums and percentages of total occurrence are given for each speed and direction class, along with mean speed, extreme speeds, mean component speeds, and standard deviations. Hourly averages of current speed, true direction, current vector, temperature, and pressure are plotted as a function of time. On 13 December, 1980, a current meter array was deployed at the Punta Tuna site and recovered on May 16, 1981. The processed current data from this current meter array are described. (LEW)

61123 **(LBL—14799) Environmental monitoring at Kahe Point, Oahu, Hawaii for OTEC pilot-plant development.** Dengler, A.T.; Harms, V.; Hartwig, E.O.; Quinby-Hunt, M.S.; Wilde, P. (Lawrence Berkeley Lab., CA (USA); USDOE, Washington, DC). Aug 1982. Contract AC03-76SF00098. 8p. (CONF-820926—4). NTIS, PC A02/MF A01. Order Number DE82020979.

From Marine Technology Society and Geological Society of America conference on oceans; Washington, DC, USA (20 Sep 1982).

Two 40 MWe Ocean Thermal Energy Conversion (OTEC) Pilot Plant programs are in the initial phase of development near Kahe Point, Oahu, Hawaii. The two options being examined are: (1) a shelf-seated artificial island, connected via a causeway to Oahu, using stainless steel heat exchangers, with the thermal resource enhanced by effluent from a near-by power plant, ammonia working fluid and biocide (chlorine) cleaning; and (2) a shelf mount tower 1 mile off shore using submerged aluminum heat exchangers, R-22 working fluid, and slurry cleaning with biocide (chlorine) backup. Environmental Technical Requirements are described including: siting criteria; environmental design, and operational criteria; thermal resource evaluation and variability; physical, chemical, and biological data requirements; and regulatory requirements. Due to siting, design, and operational differences the proposed two pilot plant options have individual environmental monitoring criteria and requirements. Due to the close spatial proximity of the proposed pilot plants they also have required environmental data which are common to both.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 61058, 61148, 61624, 61701, 61701, 61737

61124 **(DOE/CH/10122—2) Analysis of field-test data from domestic solar-water heaters in the southern United States, period through May 1982.** Jones, W.M.; Jacobs, R.A. (ESG, Inc., Atlanta, GA (USA)). Aug 1982. Contract AC02-82CH10122. 95p. NTIS, PC A05/MF A01. Order Number DE82020532.

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Monitored performance data gathered from 103 solar water heaters are presented. All except 25 of the water heaters are located in Florida. The locations and system types of the solar water heaters are tabulated. The annual energy saved, solar savings fraction, return on investment, and gallons per purchased energy are given for the systems. Analysis of the thermal performance data is discussed. The solar water heater sites are ranked according to various thermal performance values, and thermal performance data are plotted. Presented with the plots are the mean and standard error of the particular groupings of monitored data. Operational statuses causing performance interruptions are tabulated. (LEW)

61125 **(DOE/CS/30035—T2) Study and design of a multiple-slide screw compressor for use in solar-assisted heat pumps. Final report, September 1979-April 1982.** (Dunham-Bush, Inc., West Hartford, CT (USA)). 1982. Contract AC03-79CS30035. 190p. NTIS, PC A09/MF A01. Order Number DE82021001.

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The performance study and complete design of a 25-ton multiple slide helical screw compressor for application in solar assisted heat pump systems have been carried out. The work entailed testing of a 100-ton 4-slide screw compressor that had been previously built, complete conceptual and detailed design of the 4-slide 25-ton compressor and an alternate 2-slide/fixed port configuration, thorough computer simulations of compressor performance, and design of a 25-ton test loop. Partial construction of the test loop and ordering of long-lead components for fabrication was also carried out. Testing of the 100-ton prototype was done to develop slide configuration and control technique, investigate oil system behavior, and obtained performance data at high and low speed. Results were input into the 25-ton compressor design. In the performance study, computer codes were developed to carry out the thermodynamic analysis of the vapor cycle using real vapor properties from standard refrigerant property tables. It is found that either the 4-slide or 2-slide compressor is technically attractive for solar assisted heat pump application and would be able to obtain high coefficient of performance and energy conservation, but little market is expected unless solar assisted heat pumps gain interest. (LEW)

61126 **(DOE/CS/30382—1) Spancrete Industries: precast concrete passive applications. Final report.** (Wisconsin Univ., Milwaukee (USA). Energy and Buildings Research Inst.). 1982. Contract FC02-80CS30382. 198p. NTIS, PC A09/MF A01. Order Number DE82020798.

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On the thesis that concrete, being a massive material, can store large quantities of heat, a proposal was made for research, design, and development of precast concrete passive solar building systems. Warehouses and manufacturing buildings were to be the primary market for the proposed systems. Offices and school buildings were seen as secondary potential markets to be explored in later stages. The precast concrete industry is described, including precast concrete production and market applications by building type. Thermal storage walls are described, and thermal and economic analyses are performed. Hollow core floor thermal storage is also discussed in the case of an office building. (LEW)

61127 (DOE/CS/35050—T1) Data collection forms: series 10, 20, 40, and 50. Groth, G. (Lakeshore Technical Inst., Cleveland, WI (USA)). 1 Dec 1980. Contract FC02-78CS35050. 71p. NTIS, PC A04/MF A01. Order Number DE82019277.

Portions of document are illegible.

Provided are data collection forms and instructions for their use for gathering information on building and solar system design, solar system construction information, owner/user attitudinal data, purchased energy costs, and solar system maintenance. (LEW)

61128 (DOE/ET/27108—T1, pp 51-53) Drilling technology. 1981. NTIS, PC A07/MF A01.

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In Reservoir assessment of The Geysers Geothermal field.

Well drilling, logging, cementing, completion, and injection are described briefly. A generalized casing, cementing, and drilling program is shown.

61129 (DOE/SF/10542—T1) Direct expansion solar collector and heat pump. Final report. (Sigma Research, Inc., Richland, WA (USA)). May 1982. Contract AC03-79SF10542. 95p. NTIS, PC A05/MF A01. Order Number DE82014662.

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The system discussed is a hybrid heat pump/solar collector combination in which solar collectors replace the outside air heat exchanger found in conventional air-to-air heat pump systems. The solar panels ordinarily operate at or below ambient temperature, eliminating the need to install the collector panels in a glazed and insulated enclosure. The collectors simply consist of a flat plate with a centrally located tube running longitudinally. Solar energy absorbed by exposed panels directly vaporizes the refrigerant fluid. The resulting vapor is compressed to higher temperature and pressure; then, it is condensed to release the heat absorbed during the vaporization process. In the absence of solar input, the panel temperature will drop, and significant amounts of energy will be extracted from the ambient air by convection, radiation, and condensation of moisture. The direct-expansion collector design is described and compared with other flat-plate collector designs. Its operation is analyzed and models are presented that allow optimization of the design with respect to certain of its parameters. Control and monitoring of the demonstration system are addressed, and the tests conducted with the demonstration system are described. Areas are pointed out where difficulties arose, and additional work is suggested. The entire heat pump system is modelled, including predicted performance and costs, and economic comparisons are made with conventional flat-plate collector systems. Software listings of certain modelling programs are appended. (LEW)

61130 (LA—9425-MS) Some potential benefits of fundamental research for the passive solar heating and cooling of buildings. Neeper, D.A.; McFarland, R.D. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 45p. NTIS, PC A03/MF A01. Order Number DE82021257.

Potential benefits of fundamental research in materials, control of optical radiation, and enhancement of heat transfer are examined. A brief survey is given of the environmental resource for supplying the heating and cooling energy needs of buildings. It is concluded that the resource is adequate to meet most heating needs and approximately half the cooling needs by passive technology. However, for this resource to be exploited, the efficiency and control of passive systems must be dramaticaly increased. Hypothetical, but physically realistic, models for system improvements resulting from fundamental research are tested in hour-by-hour simulations of building energy flows. It was found that the expected improvement could double the efficiency of passive heating systems and permit use of any part of the building envelope for energy gain. Expected benefits in optical control could greatly reduce cooling loads. Specific examples of needed research in optical materials and heat transfer are identified.

61131 (LA-UR—82-2497) DOE passive-solar Class A performance-evaluation program: preliminary results. Hunn, B.D.; Turk, W.V.; Wray, W.O. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 10p. (CONF-820940—1). NTIS, PC A02/MF A01. Order Number DE82021761.

From Passive and hybrid solar energy update conference; Washington, DC, USA (15 Sep 1982).

The major objective of the DOE Passive Solar Class A Performance Evaluation Program is to collect, analyze, and archive detailed test data for the rigorous validation of analysis/design tools used for passive solar research and design. Elements of the plan for Class A validation are described. A proposed validation methodology, including both analytical and empirical tests, a quantitative definition of validation, minimum data requirements, and a standard reporting format, is outlined. The preliminary testing of this methodology using hourly data from two Class A test facilities is presented. Finally, the collection, analysis, and documentation of preliminary data sets is discussed.

61132 (MASEC-SCR—81-011) Financial barriers to the use of solar-industrial-process heat. (Mid-American Solar Energy Complex, Minneapolis, MN (USA); Western Reserve Associates, Cleveland, OH (USA)). Mar 1981. Contract AC02-79CS30150. 94p. NTIS, PC A05/MF A01. Order Number DE82013429.

Portions of document are illegible.

Industry concerns about solar process heat, attitudes toward investment in solar process heat, and decision processes and factors are reported. Four cases were selected from among 30 potential solar process heat installations that had been carried through the design stage, and case was analyzed using discounted cash flow to determine what internal rate of return would be earned under current tax laws over 10 years. No case showed any significant rate of return from capital invested in the solar installation. Several possible changes in the cost of solar equipment, its tax treatment or methods of financing were tested through computer simulation. A heavy load of extra tax incentives can improve the return on an investment, but such action is not recommended because they are not found to induce adoption of solar process heat, and if they were effective, capital may be drawn away from applications such as conservation were the potential to improve the nation's energy dilemma is greater. Tax shelter financing through limited partnership may be available. (LEW)

61133 (N—82-16138) Solar powered water purification system at Goldstone (DSS 13). Menninger, F.J.; Elder, R.J. (Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1981. 3p. NTIS, PC A16/MF A01.

In the telecommunications and data acquisition report, pp. 352-354. See N82-16101.

The present energy intensive electrically powered still at the Venus Deep Space Station (DSS 13) has reached its end-of-life. The electric still has been producing the pure water required for cooling the 400-kW klystron tube of the Venus 26-m antenna at Goldstone, California. A new passive solar still, unique to the Goldstone complex, has been designed to replace the electric still. This new system will deliver 100% of the pure water requirement for cooling the klystron tube and will consume an insignificant amount of electrical energy. Construction will be completed by the end of 1981, followed by a one-year test and evaluation period to gather data on performance characteristics.

61134 (NASA-CASE-NPO—15071-1) Solar heated fluidized bed gasification system. Qader, S.A. (Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1981. 5p. US Patent and Trademark Office.

A solar-powered fluidized bed gasification system for gasifying carbonaceous material is presented. The system includes a solar gasifier which is heated by fluidizing gas and steam. Energy to heat the gas and steam is supplied by a high heat capacity refractory honeycomb which surrounds the fluid bed reactor zone. The high heat capacity refractory honeycomb is heated by solar energy focused on the honeycomb by solar concentrator through solar window. The fluid bed reaction zone is also heated directly and uniformly by thermal contact of the high heat capacity ceramic

honeycomb with the walls of the fluidized bed reactor. Provisions are also made for recovering and recycling catalysts used in the gasification process. Back-up furnace is provided for start-up procedures and for supplying heat to the fluid bed reaction zone when adequate supplies of solar energy are not available.

61135 **(NP—2906044) Energy research for the farm: an overview. Agriculture Information Bulletin No. 447.** Enlow, R.E. (Agricultural Research Service, Peoria, IL (USA). North Central Region). Feb 1982. 66p. NTIS, PC A04/MF A01. Order Number DE82906044.

A general overview is provided of agricultural research activities in the area of energy as it relates to farming and ranching. Those state and federal research projects that represent research on energy and fuel for the farm are discussed briefly.

61136 **(PB—82-189077) A low energy house for a warm dry climate.** Johnson, M. (National Building Research Inst., Pretoria (South Africa)). 1980. 9p. NTIS, PC A02/MF A01.

A research project to investigate potential energy conservation and improved thermal performance in dwellings is described. Water and space heating are identified as major areas of importance in terms of energy usage. This report deals mainly with the design, construction and thermal performance of the building envelope. The installation and operation of a solar heating system using air as the heat transfer medium is also discussed.

61137 **(PB—82-190331) Solar heating of swimming pools for the subtropical coastal belt.** Forbes, J.; Dobson, D.E. (National Building Research Inst., Pretoria (South Africa)). 1980. 7p. NTIS, PC A02/MF A01.

Consideration is given to heating a swimming pool to obtain all-year-round use or alternatively to extend the use of the pool into the winter period. The report has been prepared for Durban and other parts of the subtropical Coastal Belt as a guide for advising those who may consider using solar energy for such an undertaking.

61138 **(SERI/TR—252-1438) Overview of solar industrial process-heat (SIPH) applications below 120°C.** Kreith, F.; Davenport, R. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1981. Contract AC02-77CH00178. 37p. NTIS, PC A03/MF A01. Order Number DE82021360.

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An overview of solar industrial process heat (SIPH) technologies and economics for applications below 120°C is given and a procedure for optimally matching solar systems to industrial energy requirements is outlined. Cost and system performance of operational SIPH installations are summarized, and steps required to reduce the cost of the energy delivered by future SIPH systems are presented.

61139 **(SOLAR/0024—82/41) Comparative report: performance of solar hot-water systems, 1980-1981.** Cramer, M.A.; Spears, J.W.; Pollock, E.O. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1982. Contract AC01-79CS30027. 202p. NTIS, PC A10/MF A01. Order Number DE83000069.

Data are provided on 42 solar water heater sites in the National Solar Data Network. Individual site parameters are tabulated such as collector areas, storage tank sizes, manufacturers, collector fluids, etc. Hot water heating data for 1980-1981 are tabulated and summarized, and analysis results are graphed to highlight key summary information. Observations on the performance of the systems are summarized with discussions of specific cases and conclusions which may be drawn. Specific detailed data and information necessary to support the development of results presented are appended. (LEW)

61140 **(SOLAR/1060—82/14) Solar-energy-system performance evaluation, Cathedral Square, Burlington, Vermont, July-December 1981.** Welch, K.M. (Borg-Warner Corp., Los Angeles, CA (USA). Byron Jackson Pump Div.). 1981. Contract AC01-79CS30027. 83p. NTIS, PC A05/MF A01. Order Number DE82016999.

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The Cathedral Square solar site is a 10-story multiunit apartment building in Vermont. Its active solar energy system is designed to supply 51% of the hot water load, and consists of 1798 square feet of flat plate collectors, 2699-gallon water tank in an enclosed mechanical room on the roof, and two auxiliary natural gas boilers to supply hot water to immersed heat exchanger in an auxiliary storage tank. The measured solar fraction was only 28%, not 51%, which, it is concluded, is an unreasonable expectation. Other performance data include the solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance. Monthly performance data are given for the solar system overall, and for the collector, storage, and hot water subsystems. Also included are insolation data, typical storage fluid temperatures, domestic hot water consumption, and solar heat exchangers inlet/outlet temperatures, and typical domestic hot water subsystem temperatures. In addition, the system operating sequence and solar energy utilization are given. Appended are a system description, performance evaluation techniques, long-term weather data. (LEW)

61141 **(SOLAR/1096—82/14) Gill Harrop, Big Flats, New York solar-energy-system performance evaluation, November 1980 through April 1982.** Howard, B.D. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1982. Contract AC01-79CS30027. 97p. NTIS, PC A05/MF A01. Order Number DE83000065.

The Gill Harrop site is a single family residence located in New York with a passive solar energy system designed to supply 75% of the heating load. The system is equipped with 403 square feet of windows, including 98 square feet of clerestory windows, an R-3.4 window quilt on all glazing, an 80,400-pound insulated concrete floor slab and two mass walls totalling 95,240 pounds, and electric baseboard auxiliary heaters of 9.5 kW total capacity. Monthly performance data are tabulated for the overall system and for the collector, storage, and space heating subsystems. Monthly data are also tabulated for the environment in the passive system, energy savings, and weather conditions. Also given are graphs for each month of the auxiliary energy used, ambient, storage, and building temperatures, and insolation vs. day of the month. These data are also graphed for a typical day. (LEW)

61142 **(SOLAR/1106—82/14) Rymark I, Rymark II, and Rymark III, Frederick, Maryland solar-energy-system performance evaluation, May 1981 through March 1982.** Spears, J.W. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1982. Contract AC01-79CS30027. 125p. (SOLAR/1110—82/14; SOLAR/1107—82/14). NTIS, PC A06/MF A01. Order Number DE83000067.

Portions of document are illegible.

The Rymark I, Rymark II, and Rymark III sites are single family Maryland residences whose respective passive solar energy systems are designed to supply 16%, 28%, and 42% of their heating loads. Each is equipped with a 24,000-Btu heat pump for auxiliary heating. Rymark I is equipped with 92 square feet of south-facing double-glazed windows. Rymark II is equipped with 150 square feet of south-facing triple-pane windows. Rymark III is equipped with 227 square feet of south-facing triple-pane windows with blinds and 560 square feet of phase-change ceiling tile system. The actual solar fractions achieved by the Rymark I, II, and III systems are 14%, 17%, and 20%, respectively. Monthly performance data are tabulated and compared for the overall system of each house, and for the collector, space heating, and storage subsystems. For each house and for each month, the insolation, ambient air and building temperatures, and auxiliary energy used are graphed vs. day of the month. These data are also graphed vs. hour of the day for a typical day. Monthly data are also tabulated for the environment in the passive systems, energy savings, and weather conditions. (LEW)

61143 **(SOLAR/2116—82/14) Contemporary Systems, Inc., Walpole, New Hampshire solar-energy-system performance evaluation, October 1981 through April 1982.** Howard, B.D. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1982. Contract AC01-79CS30027. 97p. NTIS, PC A05/MF A01. Order Number DE83000068.

The Contemporary Systems, Inc. site is a hybrid solar building in New Hampshire that is designed to obtain 71% of its space heating and 75% of its water heating from solar energy. The active solar system is equipped with 800 square feet of flat plate air collectors and two site-built rock bins. There is also a window wall and sunspace. The window wall is 190 square feet, double glazed, with a window quilt and a concrete floor slab. The sunspace is double glazed with CYRO polycarbonate with a 320 square foot area of glazing, and is equipped with a fan-forced 100-cubic-foot rock bin. Auxiliary water heating is electric. Monthly performance data are tabulated for the solar system overall, for the active and passive collector systems, water and space heating subsystems, and the building. Also tabulated are monthly data for the solar coefficients of performance, building environment, solar operating energy, energy savings, and weather conditions. Typical system operation is illustrated by graphs for a typical day of the hourly temperatures at different parts of the system, active heating system fluid flow rate, and total insolation. Typical system operating sequences are also graphed, as well as the solar energy use. (LEW)

61144 **Evaluating passive's potential.** Nesbit, W.; Purcell, G. *EPRI (Electric Power Research Institute) Journal;* 7: No. 6, 18-23(Jul 1982).

A flexible computer program compares the costs and thermal performance of passive solar homes with a conventional house and a well-insulated energy-conservation home. The energy-conservation home and passive solar homes significantly outperformed the conventional home at each of four sites and in each of the four comparison areas of kWh use, system load, fuel costs, and generation reliability. The best passive solar house performed incrementally better than the energy-conservation house on the heating-load-dominated systems and roughly equivalent to the energy-conservation house on the cooling-load-dominated system. Several utilities are now using the model to explore the potential impact of passive solar design in their service areas. 2 figures.

61145 **Scheduling and the energy economics of wall design.** Kennedy, W.J. Jr.; Turley, R.E. (Univ. of Utah, Salt Lake City). *American Institute of Industrial Engineers, Detroit Chapter, Proceedings of the Annual Conference;* 81-83(1981). (CONF-810538—). Detroit, MI, USA (17 May 1981).

A model is presented for use in comparing the energy consumption of various building construction types under two different work schedules. The model is general enough that it can be adapted to many different kinds of building construction; the input parameters are adaptable to the evaluation of many kinds of scheduling and many different possible combinations of unoccupied temperature settings. For the purposes of this analysis a manufacturing facility was selected which was patterned after a case study entitled Artos Company Manufacture of a Folding Step Stool. The analytical model used was the standard ASHRAE methodology for heating and cooling load calculations, combined with a procedure for computing solar heat loads.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 61058, 61061, 61097, 61117, 61671

61146 **(EIR—407) Thermal capacity and characteristics of solar collectors. Report of tests undertaken in the summer of 1978 and 1979.** Suter, J.M.; Keller, J.; Widder, F.; Kesselring, P. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1980. 138p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82902938.

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A description is given of test methods and construction of testing equipment used at the Swiss Institute for Reactor Research for the testing of various solar collectors and computation of solar collector heat capacity. Also described is the spectrophotometric equipment utilized. A list of the various solar collectors tested and their places of manufacture is also given as well as detailed tabulated data on collector technical specifications. 7 references.

61147 **(JSR—81-26) Assessment of some energy technologies associated with solar energy.** Abarbanel, H.D.; Case, K.M.; Flatte, S.M.; Nierenberg, W.A.; Watson, K.M. (SRI International, Arlington, VA (USA)). Oct 1981. Contract AC03-81ER30012. 51p. NTIS, PC A04/MF A01. Order Number DE82018220.

Three alternative solar energy generation concepts are discussed: salinity gradient solar ponds, osmotic membrane power generation, and thermochemical storage and transport. It is concluded that in specialized applications and in some special geographical circumstances, the salinity gradient solar pond can be an economically attractive way of producing 80°C to 90°C hot water or of generating electricity. Under most circumstances, however, the costs of salt, land, and pond liner will make the solar pond not competitive commercially at today's fuel prices. Power generation using osmotic membranes is not considered likely to be economically viable because of the high cost of membranes. (LEW)

61148 **(MLM—2962-OP) Heat extraction from a large solar pond.** Wittenberg, L.J.; Etter, D.E. (Mound Facility, Miamisburg, OH (USA)). Aug 1982. Contract AC04-76DP00053. 6p. (CONF-821101—9). NTIS, PC A02/MF A01. Order Number DE82019322.

From ASME winter annual meeting; Pheonix, AZ, USA (14 Nov 1982).

The largest operational, salt-gradient solar pond in the United States, occupying 2000 m^2, was constructed during 1978 in Miamisburg, Ohio. The heat from this solar pond, nearly 1055 GJ/y (1000 million Btu/y) is used to heat an outdoor swimming pool in the summer and an adjacent recreation building during part of the winter. A new heat exchanger system has been installed externally to the pond and operated successfully to deliver 391 GJ (371 million Btu) of heat during May-June. Hot brine water is drawn through a diffuser by a self-priming pump fabricated from fiberglass reinforced plastic. The brine water passes through copper-10% nickel tubes of a tube-and-shell heat exchanger and is then returned to the bottom of the pond. Cooling water from the swimming pool circulates through the shell side of the heat exchanger. Several designs and flow velocities of the brine inlet and outlet diffusers into the pond have been tested in order to minimize the effect of turbulence upon the salt gradient zone.

61149 **(NASA-CR—163472) A conceptual design study of point focusing thin-film solar concentrators. Final report.** (Boeing Engineering and Construction Co., Seattle, WA (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Nov 1981. 128p. NTIS, PC A07/MF A01.

Candidates for reflector panel design concepts, including materials and configurations, were identified. The large list of candidates was screened and reduced to the five most promising ones. Cost and technical factors were used in making the final choices for the panel conceptual design, which was a stiffened steel skin substrate with a bonded, acrylic overcoated, aluminized polyester film reflective surface. Computer simulations were run for the concentrator optics using the selected panel design, and experimentally determined specularity and reflectivity values. Intercept factor curves and energy to the aperture curves were produced. These curves indicate that surface errors of 2 mrad (milliradians) or less would be required to capture the desired energy for a Brayton cycle 816 C case. Two test panels were fabricated to demonstrate manufacturability and optically tested for surface error. Surface errors in the range of 1.75 mrad and 2.2 mrad were measured.

61150 **(SAND—81-7038) Development of sheet-metal parabolic-trough reflector panels.** Biester, A.W. (Budd Co., Fort Washington, PA (USA). Technical Center). Jun 1982. Contract AC04-76DP00789. 79p. NTIS, PC A05/MF A01. Order Number DE82016377.

Portions of document are illegible.

Efforts to develop accurate, durable, and mass producible sheet metal parabolic trough solar collectors and the associated support for the collectors are described. The design considered is similar to an automobile hood, a two-piece sheet metal structure consisting of a formed steel frame or stiffening panel and a smooth contoured skin. The two pieces may be bonded or welded to form

a rigid structure, and a reflective surface applied such as a film, glass mirror, or any of the presently utilized materials. The work encompassed material selection, adhesive selection and testing, tool design and fabrication, prototype panel production, and design and development of torque tube assemblies on which the trough is inclined. Appended are results of adhesive bonding studies. It is found that high volume technology can be used to produce accurate and structurally sound reflector panels, and one configuration has been selected for fabrication in suitable quantities for performance testing. (LEW)

61151 **(SERI/TR—255-1432) Scatterplate flux mapping for solar concentrators.** Masterson, K.; Bohn, M. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1982. Contract AC02-77CH00178. 17p. NTIS, PC A02/MF A01. Order Number DE82021359.

Developing the ability to characterize accurately the spatial distribution of solar energy at the receiver is a part of advanced solar thermal conversion technology. High power levels near the focus of a point-focus concentrator make this difficult because of the large thermal stress placed on materials and components. A scatterplate flux mapping technique developed at the Solar Energy Research Institute (SERI) that solves many material problems and the optical characteristics of several scatterplate materials are described. The errors contributed by a scatterplate with nonideal characteristics typical of the materials used are assessed.

61152 **(SERI/TR—631-1062) Analytical dynamic modeling of line-focus solar collectors.** Wright, J.D. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1981. Contract AC02-77CH00178. 58p. NTIS, PC A04/MF A01. Order Number DE82022036.

Presented is a dynamic modeling technique for line-focus solar collectors. The mathematical basis is developed to devise control strategies for industrial process heat installations. As greater use is made of line-focus collectors for both process heat and power generation, applications will be encountered that require the collector field to provide a constant fluid outlet temperature. The control design must account for the nonlinear, distributed-parameter characteristics of the process. The dynamic process analysis presented gives insight into the best control strategies available. A simplified energy balance around the collector tube yields a partial differential equation that may be solved by Laplace techniques to yield time and frequency responses of the collector to changes in insolation, inlet temperature, and flow rate.

61153 **Improved solar energy concentrator system.** Folino, F.A. US Patent Application 326,972. 3 Dec 1981. 24p.

This report describes a solar energy concentrator system having a plurality of concentrator arrays with each of the arrays being made up of a plurality of adjacent longitudinally extending concentrator modules. Each of the concentrator modules has a semi-cylindrically-shaped housing and a semi-cylindrically-shaped cover in order to form an overall cylindrically-shaped structure which provides protection from adverse environmental conditions and withstands high wind loads. Situated within the cover and connected to the housing is a parabolically-shaped concentrator. The concentrator is made up of a plurality of parallelogram-shaped reflector panels mounted adjacent one another on a bias. This arrangement permits the ends of the panels to overlap adjacent modules so as to provide a substantially continuous reflector surface. The reflector surface redirects solar energy onto a plurality of solar cells located within the cover and as a result of the physical makeup of the concentrator components substantially eliminates the problem of cell shadowing.

1420 Heat Storage

REFER ALSO TO CITATION(S) 61090, 61863

61154 **(ANL—82-50) Development of enhanced heat transfer/transport/storage slurries for thermal-system improvement.** Kasza, K.E.; Chen, M.M. (Argonne National Lab., IL (USA)). Jun 1982. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01. Order Number DE82021236.

A formulation is presented of a new concept for improving thermal-system performance by utilizing the combined mechanisms of enhanced heat transfer, transport, and thermal energy storage associated with a phase-change slurry as the working fluid. In addition, pertinent literature is surveyed and a quantitative scoping assessment of enhancement potential confirms concept merit. It has been determined that additional research and development is required in order to adequately understand the enhancement mechanisms to the degree that enhanced performance thermal systems using slurries can be designed. The concepts presented are identified as being new, rewarding research activities.

61155 **(EUR—7698-DE) Compact latent heat storage utilizing phase changes in temperature range of 320 and 340 K.** Stahl, J.; Hennemann, B. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). 1982. 40p. (In German). European Community Information Service, 2100 M Street, N.W., Suite 707, Washington, DC 20037.

Portions of document are illegible.

A study is made of economically feasible materials for heat storage for the purpose of producing a short-term heat reservoir that would allow the storage of solar energy at a medium temperature level. Tabulated data are given on the energy absorption of various paraffin-based materials as well as palmitic and stearic acid. 13 figures, 5 tables.

61156 **(SERI/TP—252-1685) Analysis of thermal-storage systems.** Copeland, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1982. Contract AC02-77CH00178. 8p. (CONF-820827—22). NTIS, PC A02/MF A01. Order Number DE82020981.

From Energy storage contractors review meeting; Arlington, VA, USA (23 Aug 1982).

During FY 1982, thermal storage systems were analyzed for solar thermal applications. Promising thermal storage concepts were identified for a liquid metal receiver in an electric power application. Both an advanced, high-temperature (1100°C maximum) molten salt system and a double-effort solar cooling system were assessed. Both systems with associated thermal storage were promising. Currently, a long duration storage system with a molten nitrate salt central receiver is being assessed.

61157 **(SERI/TP—252-1691) Direct-contact thermal-storage research.** Wright, J.; Bohn, M.S. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1982. Contract AC02-77CH00178. 9p. (CONF-820827—21). NTIS, PC A02/MF A01. Order Number DE82020989.

From Energy storage contractors review meeting; Arlington, VA, USA (23 Aug 1982).

The objective of the direct-contact thermal storage research task is to reduce the heat-transfer-related costs of thermal energy storage systems by performing research on direct-contact heat transfer. Research is presently focused on direct contact between air and molten nitrate salts. These devices have cost advantages over conventional fin-tube indirect heat exchangers and would be used to couple short-term molten salt storage to longer term air/rock storage to obtain long duration storage. These devices would also be used in very high-temperature systems that employ molten carbonates or sodium hydroxide. An experimental loop is being constructed to develop and to test methods for predicting the performance of such devices, and to test new packing designs. Work using direct-contact heat exchange on low-temperature latent heat storage in salt hydrates was concluded in FY 1982. Heat transfer was adequate, but some practical operating problems remained. The problem of oil distribution was resolved, but no solution was found for the problem of salt hydrate carryover. Because of the carryover problem, because latent heat storage in direct-contact salt hydrate systems offers only small reductions in storage volume, and because there is little potential for cost reduction compared to water storage, further research on such systems is not recommended.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 61672

61158 **(USGS-OFR—81-564) Geothermal Research Program of the US Geological Survey.** Duffield, W.A.; Guffanti, M. (Geological Survey, Menlo Park, CA (USA)). 1981. 113p. USGS - Open File Service, Box 25425 - Denver Federal Center, Denver, CO 80225.

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The beginning of the Geothermal Research Program, its organization, objectives, fiscal history, accomplishments, and present emphasis. The projects of the Geothermal Research Program are presented along with a list of references.

1501 Resource Status And Assessment

61159 **(DOE/ID/12101—5) State geothermal commercialization programs in seven Rocky Mountain states. Semiannual progress report, July-December 1981.** Lunis, B.C. (ed.). (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1982. Contract AC07-76ID01570. 201p. NTIS, PC A10/MF A01. Order Number DE82021076.

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The activities and findings of the seven state commercialization teams participating in the Rocky Mountain Basin and Range commercialization program are described. The period covered is July through December 1981. Background information is provided, program objectives and the technical approach used are discussed, and the benefits of the program are described. Prospect identification, area development plans, site specific development analyses, time-phased project plans, the aggregated prospective geothermal energy use, and institutional analyses are discussed. Public outreach activities are covered and findings and recommendations are summarized.

61160 **(DOE/SF/10855—82-4) Reconnaissance geothermal resource assessment of 40 sites in California.** Leivas, E.; Martin, R.C.; Higgins, C.T.; Bezore, S.P. (California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology). 1981. Contract FG03-80SF10855. 251p. (OFR—82-4-SAC). NTIS, PC A12/MF A01. Order Number DE82022220.

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Results are set forth for a continuing reconnaissance-level assessment of promising geothermal sites scattered through California. The studies involve acquisition of new data based upon field observations, compilation of data from published and unpublished sources, and evaluation of the data to identify areas suitable for more intensive area-specific studies. Forty sites were chosen for reporting on the basis of their relative potential for development as a significant resource. The name and location of each site is given, and after a brief synopsis, the geothermal features, chemistry, geology, and history of the site are reported. Three sites are recommended for more detailed study on the basis of potential for use by a large number of consumers, large volume of water, and the likelihood that the resource underlies a large area. (LEW)

61161 **(USGS-OFR—80-1290) Selected administrative, land, and resource data for known geothermal resources areas in Arizona, California, Idaho, Nevada, Oregon, and Washington.** Burkhardt, H.E.; Brook, C.A.; Smith, F.W. (Geological Survey, Washington, DC (USA)). 1980. 29p. Geological Survey, Open File Service, Denver Federal Center, Box 25425, Denver, CO 80225.

The data are compiled from published and unpublished classification, lease-scale evaluation, and resources assessment documents prepared by the Geological Survey and are current to December 1980. The KGRA's are listed alphabetically for each state.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 61165, 61168, 61171, 62194

61162 **(DOE/ET/27108—T1, pp 9-20) Subsurface geology.** 1981. NTIS, PC A07/MF A01.

Portions of document are illegible.

In Reservoir assessment of The Geysers Geothermal field.

The following geologic structure features are described: major rock divisions, contouring the top of the main graywacke, folds, faults, Big Sulphur Creek fault zone, and fractures. A computer generated map, contoured on first reported steam entry, was constructed from well histories. An idealized top of first steam entry map reveals five, distinct steam entry anomalies which are described. The concept of zonal upflow, lateral spreading, and dissolution, coupled with structural interpretations, form the basis for a new, structural fluid-flow model for The Geysers reservoirs.

61163 **(USGS-OFR—81-134) Reconnaissance of the Hot Springs Mountains and adjacent areas, Churchill County, Nevada.** Voegtly, N.E. (Geological Survey, Menlo Park, CA (USA)). 1981. 22p. USGS - Open File Service, Box 25425 - Denver Federal Center, Denver, CO 80225.

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A geological reconnaissance of the Hot Springs Mountains and adjacent areas, which include parts of the Brady-Hazen and the Stillwater-Soda Lake Known Geothermal Resource Areas (KGRA's), resulted in a reinterpretation of the nature and location of some Basin and Range faults. This reconnaissance took place during June-December 1975. In addition, the late Cenozoic stratigraphy has been modified, chiefly on the basis of radiometric dates of volcanic rocks by US Geological Survey personnel and others. The Hot Springs Mountains are in the western part of the Basin and Range province, which is characterized by east-west crustal extension and associated normal faulting. In the surrounding Trinity, West Humboldt, Stillwater, and Desert Mountains, Cenozoic rocks overlie basement rocks of Paleozoic and Mesozoic age. A similar relation is inferred in the Hot Springs Mountains. Folding and faulting have taken place from the late Tertiary to the present.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 61193, 61197, 62190

61164 **(DOE/ET/27108—T1, pp 21-33) Geophysics.** 1981. NTIS, PC A07/MF A01.

Portions of document are illegible.

In Reservoir assessment of The Geysers Geothermal field.

The value of geophysical data in geothermal resource exploration at The Geysers Geothermal field and vicinity is discussed. All available published and unpublished geophysical data and data interpretations for the field were gathered, and additional analyses and interpretations were performed, as needed. The gravity data include Bouguer gravity and residual gravity maps, local anomalies, steam reservoir calculations, and reservoir interpretation from gravity and geodetic changes. The magnetic data include aeromagnetic maps and a ground magnetic profile. Other data discussed include electric resistivity data, audo-magnetotelluric data, temperature measurements and heat flow, and seismological investigations.

61165 **(DOE/ET/28407—T2) Water information bulletin No. 30: geothermal investigations in Idaho. Part 11. Geological, hydrological, geochemical and geophysical investigations of the Nampa-Caldwell and adjacent areas, southwestern Idaho.** Mitchell, J.C. (ed.). (Idaho Dept. of Water Resources, Boise (USA)). Dec 1981. Contract AS07-77ET28407. 153p. NTIS, PC A08/MF A01. Order Number DE82020789.

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The area under study included approximately 925 sq km (357 sq mi) of the Nampa-Caldwell portion of Canyon County, an area within the central portion of the western Snake River Plain immediately west of Boise, Idaho. Geologic mapping, hydrologic, geo-

chemical, geophysical, including detailed gravity and aeromagnetic surveys, were run to acquire needed data. In addition, existing magnetotelluric and reflection seismic data were purchased and reinterpreted in light of newly acquired data.

61166 **(DOE/ID/12033—T1) Drilling report: State Nursery test well No. 1.** Donovan, J.; Sonderegger, J. (Montana Bureau of Mines and Geology, Butte (USA)). 27 Aug 1982. Contract FC07-79ID12033. 12p. NTIS (US Sales Only). Order Number DE82021740.

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A geothermal test well was sited and drilled approximately 0.8 miles (1.3 km) east of Broadwater Hot Springs, near Helena, Montana. The site is on the property of the State Nursery, along the north side of Ten Mile Creek. The purpose of the drilling was to test a thermal infrared imagery anomaly and to evaluate whether a source of warm water for space heating of a series of new greenhouses could be developed to replace ones destroyed in the spring 1981 flooding of Ten Mile Creek. The well was drilled to 280 feet total depth, with no success in obtaining hot or even warm water.

61167 **(DOE/SF/10855—T1) Resource investigation of low- and moderate-temperature geothermal areas in San Bernardino, California. Part of the third year report, 1980-81, of the US Department of Energy-California State-Coupled Program for Reservoir Assessment and Confirmation.** Youngs, L.G.; Bezore, S.P.; Chapman, R.H.; Chase, G.W. (California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology). Aug 1981. Contract FG03-80SF10855. 397p. NTIS, PC A17/MF A01. Order Number DE82020721.

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Ninety-seven geothermal wells and springs were identified and plotted on a compiled geologic map of the 40-square-mile study area. These wells and springs were concentrated in three distinguishable resource areas: Arrowhead Hot Springs; South San Bernardino; and Harlem Hot Springs - in each of which detailed geophysical, geochemical, and geological surveys were conducted. The Arrowhead Hot Springs geothermal area lies just north of the City of San Bernardino in the San Bernardino Mountains astride a shear zone (offshoot of the San Andreas fault) in pre-Cambrian gneiss and schist. The Harlem Hot Springs geothermal area, on the east side of the City, and the south San Bernardino geothermal area, on the south side, have geothermal reservoirs in Quaternary alluvial material which overlies a moderately deep sedimentary basin bound on the southwest by the San Jacinto fault (a ground water barrier). Geothermometry calculations suggest that the Arrowhead Hot Springs geothermal area, with a maximum reservoir temperature of 142°C, may have the highest maximum reservoir temperature of the three geothermal areas. The maximum temperature recorded by CDMG in the south San Bernardino geothermal area was 56°C from an artesian well, while the maximum temperature recorded in the Harlem Hot Springs geothermal area was 49.5°C at 174 meters (570 feet) in an abandoned water well. The geophysical and geological surveys delineated fault traces in association with all three of the designated geothermal areas.

61168 **(EUR—7113-IT) Villaverla 1 well. Interpretation of production tests. Final report.** (AGIP Nucleare, Milan (Italy)). 1981. 53p. (In Italian). European Community Information Service, 2100 M St., N.W., Washington, DC 20037.

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A description is given of tests made of the water-pumping productivity of the Villaverla well in the province of Vicenza in limestone at levels of 1500 and 2400 meters at water temperatures of 75°C at 2300 meters for possible geothermal utilization. Tabulated data are given on the water samples taken from the well with respect to water temperature, elevation, water velocity, and other hydrodynamic parameters. The interpretative results indicate that there are very high headwater losses in the well that considerably exceed the losses attributable to aquiferous flow. 28 tables.

61169 **(EUR—7578-DE) Seismic studies for the determination of the crustal structure in the region of the geothermal anomaly of Tuscany.** Giese, P.; Wigger, P.; Morelli, C.; Nicolich, R. (Commission of the European Communities, Luxembourg. Directorate-General for Research, Science and Education). 1981. 108p. (In German). Commission of the European Communities, Luxembourg.

Within this project the crustal and upper mantle structure in the region of the strongest continental European geothermal anomaly - the western parts of Tuscany and adjacent areas - have been investigated by seismic and magnetotelluric methods. The distribution of the seismic velocities and the electrical resistivity gives hints at anomalous temperatures in the crust and upper mantle and how far their extension is, and by which mechanism the geothermal anomaly is caused. Seismic velocities as well as the electrical resistivity decrease at increasing temperatures. Accordingly this program comprises two parts: 1) the study of the seismic velocity distribution and 2) the study of the electrical resistivity distribution. This report gives information about the results of the seismic measurements.

61170 **(USGS-OFR—81-1330) Volcanic stratigraphy and secondary mineralization of U.S.G.S. Pucci geothermal test well, Mount Hood, Oregon.** Gannett, M.W.; Bargar, K.E. (Portland State Univ., OR (USA). Dept. of Earth Sciences; Geological Survey, Menlo Park, CA (USA)). 1981. 27p. Geological Survey, Open-File Services Section, P.O. Box 25425, Denver Federal Center, Denver, CO 80225.

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Ninety-one sample splits of drill cuttings from approximately 6.1 m intervals in the 610 m hole that was completed in 1979 were provided for this study. An additional 225 sample splits (3.05 m intervals) from 536 m to the bottom of the drill hole at 1220 m were added to the study following the deepening of the drill hole. Stratigraphic and petrologic observations of the cuttings were made. Scanning electron microscope and x-ray diffractometer examinations were made of alteration minerals. The lithology and secondary mineralization are discussed.

61171 **(USGS-OFR—81-1345) Gravity and magnetic features and their relationship to the geothermal system in southwestern South Dakota.** Hildenbrand, T.G.; Kucks, R.P. (Geological Survey, Washington, DC (USA)). 1981. 48p. Geological Survey, Open File Service, Denver Federal Center, Box 25425, Denver, CO 80225.

An attempt is made to determine the sources that are responsible for producing geothermal anomalies observed within the southern Black Hills region. Lithologic and structural boundaries residing in the upper crust and their relationship to the geothermal system are discussed. A regional gravity survey was supplemented by a regional aeromagnetic survey.

1504 Legal And Institutional Aspects

61172 **(CONF-811249—) Conference on legal aspects of geothermal development.** (Geothermal Resources Council, Davis, CA (USA); American Bar Association, Chicago, IL). 1981. 271p. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

Portions of document are illegible.

Fifteen papers and abstracts are included. Separate abstracts were prepared for six papers and nine abstracts were listed by title.

61173 (CONF-811249—, pp 48p, Section I) **Geothermal energy and national energy goals.** Zillman, D.N.; Naumann, S. (Univ. of Utah, Salt Lake City). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

The role of law in the production and use of energy resources is discussed. The way the Reagan Administration is changing energy law is examined. How these changes have influenced

and are likely to influence the Reagan Administration with regard to geothermal development is explored.

61174 (CONF-811249—, pp 28p, Section III) **Unitization of geothermal resources: back to basics.** Hieronymus, E.W. (O'Melveny and Myers, Los Angeles, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

Six basic issues in the unitization process are addressed: the land to be included, the parties involved, allocation of costs, allocation of production, decision-making, and lessee's obligations. Both voluntary and compulsory unitization imposed by a government agency are discussed.

61175 (CONF-811249—, pp 29p, Section IV) **Water law and the development of geothermal resources.** Olpin, O.; Thompson, B.H. (O'Melveny and Meyers, Los Angeles, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

Western water law is surveyed briefly. The necessity of abiding by state water law in geothermal development is discussed and compliance problems under state groundwater law are described. Some possible ways out of the conflicts are presented and some recommendations are made for both geothermal developers and for the state.

61176 (CONF-811249—, pp 3p, Section V) **Federal lands and geothermal resources management programs.** Conover, R.D. (Dept. of the Interior, Riverside, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

61177 (CONF-811249—, pp 2p, Section VI) **Geothermal leasing from producer's point of view.** Trower, D. (AMAX Exploration, Inc., Golden, CO). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

61178 (CONF-811249—, pp 9p, Section VII) **Geothermal leasing from a landowner's point of view.** Byrd, W.N. (Byrd, Sturdevant, and Krutzch, Brawley, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

61179 (CONF-811249—, pp 3p, Section IX) **Local government planning and regulations of geothermal resources development.** Harmon, J.H. (Imperial County Counsel's Office, El Centro, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

61180 (CONF-811249—, pp 3p, Section X) **Strategies for a successful geothermal permitting process in Lake County.** Bridges, R.L. (Senior Deputy County Counsel, Lakeport, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

61181 (CONF-811249—, pp 10p, Section XI) **Proposition 13: appraisal and ad valorem taxes on geothermal resources in California.** Bertholf, H.W. (Harold W. Bertholf and Associates, Sacramento, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

61182 (CONF-811249—, pp 62p, XII) **Income taxation of geothermal resources.** Maxfield, P.C. (Univ. of Wyoming, Laramie). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

The state of the federal income tax laws is outlined as applied to geothermal resources with particular emphasis on newer developments such as the Energy Tax Act of 1978.

61183 (CONF-811249—, pp 4p, Section XIV) **Role of counsel in the sale and purchase of a producing geothermal property: a case history.** Laybourne, E.B. (MacDonald, Halsted and Laybourne, Los Angeles, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

61184 (CONF-811249—, pp 31p, Section XV) **Construction and operation of geothermal electric power plants on lands patented under the Stock-Raising Homestead Act of 1916 or what do you do with a bucket of steam.** Tanke, T.J. (Knudson, Tanke and Scholz, San Francisco, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

A problem involved in the Homestead Act is whether geothermal steam is a mineral reserved to the government under the Act or a part of the water rights owned by the homesteaders in their surface estate. It was ruled that geothermal steam is a reserved mineral. Since geothermal steam is not transportable, the question arises as to whether the reservation is broad enough to allow power generation facilities without the consent of the homesteaders. An argument in favor of mineral lessee is presented.

1505 Economic And Financial Aspects

61185 (CONF-811249—, pp 28p, Section II) **Geothermal sales contracts.** Humphrey, R.L. (Union Oil Co., Los Angeles, CA); Parr, C.J. 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

Contracts for the sale and purchase of high temperature geothermal steam for the generation of electric power are discussed. The following topics are covered: dedication of the resource; term; development; subsequent generation facilities; generating plant siting; production; pricing methods; indemnification, warranties, and damages; and relief for failure to perform.

61186 (CONF-811249—, pp 1p, Section XIII) **Capital for geothermal energy development.** Worcester, T.E. (Sherman and Howard, Denver, CO). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

61187 **(P—700-82-005) Cumulative impacts study of The Geysers KGRA: public-service impacts of geothermal development.** Matthews, K.M. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). May 1982. 277p. NTIS (US Sales Only). Order Number DE82905249.

Portions of document are illegible.

Geothermal development in The Geysers KGRA has affected local public services and fiscal resources in Sonoma, Lake, Mendocino, and Napa counties. Each of these counties underwent rapid population growth between 1970 and 1980, some of which can be attributed to geothermal development. The number of workers currently involved in the various aspects of geothermal development in The Geysers is identified. Using three different development scenarios, projections are made for the number of power plants needed to reach the electrical generation capacity of the steam resource in The Geysers. The report also projects the cumulative number of

workers needed to develop the steam field and to construct, operate, and maintain these power plants. Although the number of construction workers fluctuates, most are not likely to become new, permanent residents of the KGRA counties. The administrative and public service costs of geothermal development to local jurisdictions are examined and compared to geothermal revenues accruing to the local governments. Revenues do not cover the immediate fiscal needs resulting from increases in local road maintenance and school enrollment attributable to geothermal development. Several mitigation options are discussed, and a framework is presented for calculating mitigation costs per unit of public service.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 62164, 62165

61188 (CONF-811249—, pp 1p, Section VIII) **Environmental problems and geothermal permitting.** Windrem, P.F. (Windrem, and Feeney, Lakeport, CA). 1981. Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

From Conference on legal aspects of geothermal development; Newport Beach, CA, USA (3 Dec 1981).

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 61187

61189 (DOE/ET/27108—T1, pp 5-8) **Geysers Geothermal field.** 1981. NTIS, PC A07/MF A01.

Portions of document are illegible.

In Reservoir assessment of The Geysers Geothermal field.

Following a brief history of the development of The Geysers Geothermal field, information power plants, under operation and projected for completion is given.

61190 **(DOE/ET/28425—T1) High geothermal energy utilization geothermal/fossil hybrid power cycle: a preliminary investigation.** Grijalva, R.L.; Sanemitsu, S.K. (Burbank City Public Service Dept., CA (USA)). Nov 1978. Contract FG03-77ET28425. 92p. NTIS, PC A05/MF A01. Order Number DE82021365.

Combining geothermal and fossil fuel energy into the so-called hybrid cycle is compared with a state-of-the-art double-flash geothermal power cycle using resources which vary from 429°K (312°F) to 588°K (598°F). It is demonstrated that a hybrid plant can compete thermodynamically with the combined output from both a fossil-fired and a geothermal plant operating separately. Economic comparison of the hybrid and double-flash cycles is outlined, and results are presented that indicate the performance of marginal hydrothermal resources may be improved enough to compete with existing power cycles on a cost basis. It is also concluded that on a site-specific basis a hybrid cycle is capable of complementing double-flash cycles at large-capacity resources, and can operate in a cycling load mode at constant geothermal fluid flow rate.

61191 **(DOE/ET/28425—T2) Continuing site-specific and design analysis of hybrid geothermal/fossil power plants.** Simay, G.L.; Anno, G.H.; Dore, M.A. (Burbank City Public Service Dept., CA (USA); Pacific Sierra Research Corp., Santa Monica, CA (USA)). Jun 1978. Contract FG03-77ET28425. 129p. NTIS, PC A07/MF A01. Order Number DE82021564.

Portions of document are illegible.

A preliminary economic analysis of a hybrid geothermal/coal power plant is given for ten geothermal resource areas: Beowawe (NE), Brady-Hazen (NE), Brawley (CA), Coso (CA), East Mesa (CA), Long Valley (CA), Monroe-Joseph (UT), Niland (CA), Roosevelt (UT), and Surprise Valley (CA). Wasatch-Emery coal is the principal coal source; Victorville, California, the transmission delivery point. Beowawe, Coso, Monroe-Joseph, and Roosevelt are the most economically favorable sites when compared with an all-coal plant near the source of coal. A subcritical cycle is used in which geothermal energy preheats the boiler feedwater in countercurrent heat exchange. The supercritical cycle is found to offer no appreciable economic advantage over the subcritical cycle. In addition, flashing the geothermal fluid could make economic sense for a high-temperature, high-salinity resource.

61192 **Enhancement on vertical fluted surfaces.** Michel, J.W. (Oak Ridge National Lab., TN). pp 325-344 of Power condenser heat transfer technology. Computer modeling/design/fouling. Marto, P.J.; Nunn, R.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1981).

A brief discussion of Professor Ralph L. Webb's paper, The Use of Enhanced Surface Geometries in Condensers, is given with emphasis on the importance of overall cost optimization in the application of heat transfer enhancement. A review of ORNL condensation experiments with enhanced surfaces is presented. The work has centered on optimizing the design variables associated with fluted surfaces on vertical tubes and comparing the tube performance with available enhanced tubes either for vertical or horizontal operation. Data with seven fluids including a hydrocarbon, fluorocarbons, and ammonia condensing on up to 30 different tubes have been obtained. The primary conclusion from this work is that fluted tubes can provide an enhancement in condensation coefficient of a factor of 6 over smooth vertical tubes and a factor of 2 over enhanced commercial tubes either operating vertically or horizontally. These data, together with field test data, have formed the basis for designing a prototype condenser for the 500 kWe East Mesa, California, direct-contact geothermal demonstration plant.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 61199, 61199

61193 **(DOE/ER/02534—8) Seismological investigation of crack formation in hydraulic rock fracturing experiments and in natural geothermal environments. Progress report, September 1, 1981-August 31, 1982.** Aki, K. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1982. Contract AC02-76ER02534. 60p. (COO—2534-8). NTIS, PC A04/MF A01. Order Number DE82021615.

Portions of document are illegible.

Accomplishments during the present reporting period are: high-quality digital data obtained in the crater and the flank of Mt. St. Helens by the deployment of 9 event-recorders; discovery of striking differences in arrival times and amplitudes of seismic events between the crater station and flank stations; successful interpretation of the above observations by a powerful new method of seismogram synthesis called Gaussian Beam Method; evidence obtained at Mt. St. Helens for a close connection between the volcanic tremor and so-called long-period events; further development of our volcanic tremor model by including acoustic vibration in magma; and development of a high-temperature small-diameter borehole seismograph for use in search of a magma reservoir by listening to seismic events due to thermal stress.

61194 **(DOE/ET/27026—T3) Drill pin failure-analysis report.** Anliker, D. (Radian Corp., Austin, TX (USA)). Jul 1980. Contract AC02-79ET27026. 15p. NTIS, PC A02/MF A01. Order Number DE82021809.

A cracked drill pin was received from ENEL's Sasso 22 geothermal well with a request for failure analysis. Failure reportedly occurred during temperature measurements inside the drill pipe. This drill pipe had been put into the 4000 meter (13,124 ft.) hole for instrument protection about 80 hours before temperature measurements. The temperature measured at the bottom of the hole was 380°C (716°F). The liquid level was at 2000 meters (6562 feet) depth, and the temperature at that depth was 95°C (203°F). Information on the depth where failure of this pin occurred was not given. Numerous drill string failures of this type have been reported at depths greater than 3000 meters (9843 feet) by ENEL. A mixture of 70% river water and 30% condensate from a nearby geothermal power plant was being used as drilling fluid. The average chemical composition of the power plant wastewater is given. This region of Italy is known as the Boraciferous Region. The average chemistry of the Boraciferous geothermal fluid is given. The failed drill pin was reportedly made of 38 NC D4 steel.

61195 (DOE/ET/27108—T1, pp 35-49) **Reservoir assessment.** 1981. NTIS, PC A07/MF A01.

Portions of document are illegible.

In Reservoir assessment of The Geysers Geothermal field.

The reservoir description includes rock properties, fluid characteristics, initial reservoir pressure and temperature, pressure buildup behavior, and reservoir volume and heat content. Projection and injection characteristics cover individual well production behavior, field production history, and water injection. Four methods used to analyze the reservoir at The Geysers, material-energy balance, decline curve analysis, volumetric analysis, and heat recovery, are described.

61196 **(DOE/ET/27146—T12) Chemical stimulation of geothermal injection wells.** Vetter, O.J.; Kandarpa, V. (Vetter Research, Costa Mesa, CA (USA)). 23 Jun 1982. Contract AC03-78ET27146. 34p. NTIS, PC A03/MF A01. Order Number DE82021794.

Various types of chemical stimulation methods have been considered. High pH fluids seem to be a logical choice for some wellbore and/or reservoir stimulations. However, forming of secondary deposits and creating of new reservoir damages due to chemical reactions between the rock material and these stimulation fluids make it advisable not to consider any of these high pH fluids in high temperature geothermal reservoirs. Fluids having a neutral pH can be successfully used in chemical stimulation methods only in a very few and rare instances. Low pH fluids, i.e. acids, have by far the best chance to be used for these chemical stimulation jobs. The major part of this report is concerned with acidizing techniques for geothermal injection wells. The acidizing techniques to be used for an experimental and the routine stimulation of injection wells are described. Some recent field experiences and the results of some laboratory work are described.

61197 **(SAND—81-0100) Magma Energy Research Project, FY80 annual progress report.** Colp, J.L. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Apr 1982. Contract AC04-76DP00789. 109p. NTIS, PC A06/MF A01. Order Number DE82021128.

The technical feasibility of extracting energy from magma bodies is explored. Five aspects of the project are studied: resource location and definition, source tapping, magma characterization, magma/material compatibility, and energy extraction.

61198 **(SAND—82-7055) Effect of molybdenum plus chromium on the corrosion of iron-, nickel-, and cobalt-base alloys in basaltic lava and simulated magmatic gas at 1150°C.** Ehrlich, S.A.; Douglass, D.L. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jun 1982. Contract AC04-76DP00789. 79p. NTIS, PC A05/MF A01. Order Number DE82021127.

Portions of document are illegible.

The compatibility of several binary and ternary alloys in a magma environment was studied. Binary alloys containing molybdenum and ternary alloys containing chromium and molybdenum were exposed to basaltic lava at 1150°C for periods of 24 and 96 hours. A cover gas was used to produce oxygen and sulfur fugacities corresponding to those of the gases dissolved in basaltic melts. Three base metals were used. These included iron, nickel, and cobalt. The primary reactions in binary alloys were found to be sulfidation. Oxide scales with a spinel layer formed on ternary alloys. The synergistic effect of molybdenum and chromium additions in ternary alloys exhibited superior corrosion resistance to binary alloys which formed base-metal sulfides down grain-boundaries. Extensive analyses of the reaction products by scanning electron microscopy, X-ray energy dispersive analysis, electron microprobe analysis, and metallography are presented for each alloys. The products formed are discussed with reference to thermodynamic stability diagrams, and the reaction path concept is used to explain some of the corrosion.

1510 Direct Energy Utilization

61199 **(DOE/ET/28424—6) Direct utilization of geothermal energy resources in food processing. Final report, May 17, 1978-May 31, 1982.** Austin, J.C. (Ore Ida Foods, Inc., Boise, ID (USA); CH2M Hill, Boise, ID (USA)). May 1982. Contract AC07-78ET28424. 138p. NTIS, PC A07/MF A01. Order Number DE82019753.

Portions of document are illegible.

In early 1978 financial assistance was granted for a project to utilize geothermal energy at Ore-Ida Foods, Inc.'s food processing plant in Ontario, Oregon. Specifically, the project included exploring, testing, and developing the potential geothermal resource; retrofitting the existing gas/oil-fired steam system; utilizing the geothermal resource for food processing, space heating, and hot potable water; and injecting the spent geothermal water back into a disposal well. Based on preliminary investigations which indicated the presence of a local geothermal resource, drilling began in August 1979. Although the anticipated resource temperature of 380°F was reached at total well depth (10,054 feet), adequate flow to meet processing requirements could not be obtained. Subsequent well testing and stimulation techniques also failed to produce the necessary flow, and the project was eventually abandoned. However, throughout the duration of the project, all activities were carefully monitored and recorded to ensure the program's value for future evaluation. This report presents a culmination of data collected during the Ore-Ida project.

61200 **(PB—82-185430) Data collection and analysis for geothermal research. Final report.** Nydahl, J.; Pell, K.; Senser, D.; Twitchell, G.; Ownbey, S. (Wyoming Univ., Laramie (USA). Dept. of Mechanical Engineering). Aug 1981. 128p. NTIS, PC A07/MF A01.

A prototype bridge deck heating system that utilizes heat pipes to transfer the energy between a warm water source and the deck surface was tested for possible use on some of the I-70 structures through the geothermally active Glenwood Canyon. At water flow rates around 35 GPM and temperatures of 25C, the snow cover duration on the 59 square meters of heated surface was reduced between 96 and 100% and the deck's frozen time was reduced between 85 and 95% for the five different heat pipe configurations tested; this despite the fact that over a 1/4 in. thick sludge was deposited on all the unprotected metallic surfaces exposed to the geothermal water which caused the system's thermal resistance to double. If this system is to be viable for this application, a durable, protective coating with a low thermal resistance must be found to prevent both fouling and corrosion. The thermal analysis indicates that up to two hundred of these units can be placed in series with a tolerable degradation in the last unit's performance for water flow rates above 100 GPM.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 62198

61201 **Heat capacities and entropies of Mg_2SiO_4, Mn_2SiO_4, and Co_2SiO_4 between 5 and 380 K.** Robie, R.A. (U.s. Geological Survey, Reston, VA); Hemingway, B.S.; Takei, H. *American Mineralogist;* 67: No. 5-6, 470-^2(May 1982).

The heat capacities of synthetic single crystals of Mg_2SiO_4 (foresterite), Mn_2SiO_4 (tephroite), and Co_2SiO_4 (cobalt olivine), were measured between 5 and 380 K using an adiabatically shielded calorimeter. Mg_2SiO_4 is diamagnetic, and its heat capacity follows a normal sigmoidal curve at low temperatures. Co_2SiO_4 shows a single sharp λ-type transition at 49.85 +/- 0.02 K associated with the antiferromagnetic ordering of the magnetic moments of the Co^{2+} ions into a collinear spin arrangement below 49.8 K. In contrast to Co_2SiO_4 Mn_2siO_4 has two transitions in C/sup o//sub p/, a sharp λ-type transition at 47.38 +/- 0.05 K and a smaller "shoulder" in C/sup o//sub p/ centered near 12 K. The upper transition corresponds to the paramagnetic (disordered) to collinear antiferromagnetic ordering of the Mn^{2+} moments, whereas the shoulder near 12 K corresponds to the change from the collinear to a canted spin

structure. Our calorimetric values for the antiferromagnetic-paramagnetic transition temperature (Neel Temperature) are in excellent agreement with those obtained by powder magnetic susceptibility measurements, 49 +/- 2 K and 50 +/- 5 K for Co_2SiO_4 and Mn_2SiO_4 respectively. The thermal Debye temperature, Θ/sup C// sub D/, of Mg_2SiO_4 calculated from our C/sup o//sub p/ measurements between 6.3 and 13.8 K is 768 +/- 15 K and agrees well with the elastic value Θ/sup E//sub D/ of 758 K based on the mean sound velocity calculated from the room temperature elastic stiffness constants (c/sub ij/) of Graham and Barsch. At 298.15 K (25°C) the molar heat capacities are 118.6, 128.7, and 133.4 J/(mol . K) and the molar entropies are 94.11 +/- 0.10, 155.9 +/0 0.4 and 142.6 +/- 0.2 J/(mol . K) respectively for Mg_2SiO_4, $Mn=2SiO_4$, and Co_2SiO_4.

61202 **Heat capacity and entropy of fayalite (Fe_2SiO_4) between 5.1 and 383 K: comparison of calorimetric and equilibrium values for the QFM buffer reaction.** Robie, R.A. (U.S. Geological Survey, Reston, VA); Finch, C.B.; Hemingway, B.S. *American Mineralogist;* **67**: No. 5-6, 463-469(May 1982).

The heat capacities of large synthetic crystals of fayalite (Fe_2SiO_4) grown by the Czochralski technique were measured between 5.1 and 381.5 K. The heat capacity exhibits an extremely sharp λ-transition at 64.88 +/- 0.03 K corresponding to the paramagnetic-antiferromagnetic inversion, and a smaller hump centered near 16 K, corresponding to a spin structure change from a collinear to canted antiferromagnetic arrangement. At 298.15 K, C/sup o//sub p/ and S/sup o/ for fayalite are respectively 131.9 +/- 0.1 and 151.0 +/- 0.2 J/(mol . K). From a third law analysis of six sets of high-temperature reactions involving fayalite, we obtained ΔH/sup o//sub $f,_{298}$ = 1478.17 +/- 1.30 and ΔG/sup o//sub $f,_{298}$ = -1378.98 +/- 1.35 kJ/mol.Using these new data for Fe_2SiO_4, we calculated the temperature dependence of the equilibrium constant for the reaction $2Fe_3O_4 + 3SiO_2 = 3Fe_2SiO_4 + O_2$; i.e., the quartz-fayalite-magnetite buffer reaction. Our values for ΔG/sup o//sub f,T/ are within 0.70 kJ of those obtained from Hewitt's equation.

61203 **Amorphous silica solubilities IV. Behavior in pure water and aqueous sodium chloride, sodium sulfate, magnesium chloride, and magnesium sulfate solutions up to 350°C.** Chen, C.T.A.; Marshall, W.L. (Oak Ridge National Lab., TN). *Geochimica et Cosmochimica Acta;* **46**: No. 2, 279-287(Feb 1982).

Solubilities of amorphous silica were determined in separate aqueous solutions of sodium chloride, sodium sulfate, magnesium chloride, and magnesium sulfate at temperatures up to 350°C. These salts, of strong interest in hydrothermal oceanography and geothermal energy, generally ranged in concentration from zero to saturation. Solubilities in the sodium chloride solutions followed closely earlier observed decreases in sodium nitrate solutions at high temperatures. Amorphous silica solubilities were depressed most by magnesium chloride, followed by magnesium sulfate, and less by sodium chloride. As the temperature rose the relative decrease in solubility caused by added salt became smaller. Surprisingly, sodium sulfate solutions, showing little effect at 25°C, sharply raised the solubility as the temperature increased to 350°C. Plots of the logarithms of derived activity coefficients against molalities of added salt gave approximately straight lines. These plots allow simple predictions of amorphous silica solubility in single salt solutions.

61204 **Amorphous silica solubilities V. Predictions of solubility behavior in aqueous mixed electrolyte solutions to 300°C.** Marshall, W.L.; Chen, C.T.A. (Oak Ridge National Lab., TN). *Geochimica et Cosmochimica Acta;* **46**: No. 2, 289-291(Feb 1982).

Solubilities of amorphous silica in several aqueous electrolyte solutions up to 300°C fit the Setchenow equation, log (S^o/s) = D x m, where s^o and s are molal solubilities of silica in pure water and salt solution, respectively, m is the molality of salt, and D is a proportionality constant related to the particular salt and temperature. It is now shown that, to a first approximation, the D parameters for various salts at the same temperature are additive. For instance, D(NaCl) - D(KCl) = D($NaNO_3$) - D(KNO_3) or D($MgSO_4$) = D($MgCl_2$) + D(Na_2SO_4) - 2D(NaCl). It also follows that log (s^o/s) = Σ/sub i/ (D/sub i/m/sub i/). This additivity principle was used to estimate amorphous silica solubilities in mixed NaCl-$NaSO_4$, NaCl-$MgCl_2$, NaCl-$MgSO_4$, Na_2SO_4-$MgCl_2$, Na_2SO_4-$MgSO_4$, and $MgCl_2$-$MgSO_4$ aqueous solutions up to 300°C. The method produces results that agree reasonably well with experimental values and would be useful for predicting silica solubilities, for example, in seawater and its hydrothermal concentratrates and in geothermal energy applications.

17 WIND ENERGY

61205 **(AD-A—114418/7) Study of a wind energy conversion system in New Hampshire. Final report.** Lockwood, J.; Kraft, G.; Pregent, G.; Smukler, L. (New Hampshire Univ., Durham (USA)). Aug 1981. 156p. NTIS, PC A08/MF A01.

Concern over conventional energy costs and supplies is currently strong, particularly in New England region where eighty percent of the total energy is oil based; furthermore, forty percent of this region's total energy is OPEC oil. These figures contrast with national averages of forty-seven and thirteen percent, respectively (1). The quest to develop alternative and renewable energy sources indigenous to New England is understandable in light of these figures. The wind is one such source. The study of wind energy can be divided into three basic areas; these are technical, legal-institutional, and financial. The technical area encompasses collection and analysis of wind data, selection and installation of wind turbines and peripheral equipment, and operation and maintenance. The legal-institutional area encompasses the resolution of such issues as land use policies, power contracts, and state and federal regulations. The financial area encompasses the examination of investment opportunities made available by various site-machine combinations and the selling of such opportunities to the investment community.

61206 **Home wind power.** Charlotte, VT; Garden Way Publishing Company (1981). 208p. Garden Way Publishing, Charlotte, VT 05445 $10.95.

An outline for determining the practicality of wind energy for a particular situation is presented. Information includes the basics of wind power theory, wind behavior, site selection considerations, electric and mechanical load estimation, energy storage, wind energy conversion systems, rotor construction and control, electric power generation, generator and regulator performance, wind towers, economic analysis, legal hurdles, and a resource assessment. A catalog of products and companies active in the field of wind power is included also. (MJF)

61207 **Program overview for the Wind Characteristics Program Element of the United States Federal Wind Energy Program.** Wendell, L.L.; Elderkin, C.E. (Battelle Pacific Northwest Laboratory, Richland, Wash.). pp 160-166 of Symposium on turbulence, diffusion, and air pollution, 4th, Reno, NV, January 15-18, 1979, preprints. Boston, MA; American Meteorological Society (1978).

From 4. symposium on turbulence, diffusion and air pollution; Reno, NV, USA (15 Jan 1979).

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 61223

61208 (Juel-Spez—108, pp 1-16) **Meteorological data basis.** Jarass, L. Apr 1981. NTIS (US Sales Only), PC A06/MF A01.

From Meeting of experts of Annex III and IIIa integration of wind power into national electricity supply systems; Regensburg, F.R. Germany (29 Jan 1981).

Wind speed and direction data of many years from 16 observation points in the Federal Republic of Germany were evaluated. The data are hourly mean figures for wind speed and direction measured at heights of 10 m to 30 m above ground, with some data taken at heights of up to 290 m. Some results are discussed for: mean wind speeds, daily and seasonal time variation of wind speed, temporal distribution of wind speeds, occurrence of long-lasting

lulls, correlation of wind speeds, extreme wind velocities, wind directions, and locations favorable for wind power generation. (LEW)

61209 **(PNL—3890) Wind-direction-probability design criteria for use in WECS development.** Koepf, D.; Frost, W. (FWG Associates, Inc., Tullahoma, TN (USA)). Mar 1980. Contract AC06-76RL01830. 35p. NTIS, PC A03/MF A01. Order Number DE82021377.

The design criteria recommended in the Engineering Handbook on the Atmospheric Environmental Guidelines for Use in Wind Turbine Generator Development (Handbook) for the probability of wind direction are described in detail. The design equations and graphs from the Handbook are compared with the available data. The bivariate directional probability model given in the Handbook underpredicts the measured data. A trivariate model is developed which improves the accuracy of the predicted results to a standard deviation of +- 5.8 percent. It is recommended that the Handbook be updated to incorporate the trivariate model.

61210 **Meteorological aspects of the utilization of wind as an energy source.** Geneva, Switzerland; World Meteorological Organization (1981). 201p. World Meteorological Organization, Geneva, Switzerland.

The application of meteorological data and knowledge to the planning and operation of wind energy conversion systems (WECS) is discussed. The development of WECS and WMO activities related to energy matters, with special regard to wind energy, is reviewed. Atmospheric circulation systems of various scales, atmospheric turbulence, and the boundary layer are considered, including numerical models. Wind energy technology, i.e., the different types of wind machines (both small and large conversion systems) together with their usual possibilities of application, and the environmental impact of WECS, which should be kept in mind in the planning stage in order to reduce it to a minimum, are treated. As to wind energy meteorology, the requirements for, and the availability of, meteorological data for use in the exploratory, planning and operational phases of WECS are determined. The economic aspects of deciding on the establishment of wind energy systems are also indicated. A world map, illustrating the global distribution of wind energy potential is included.

1704 Economics

REFER ALSO TO CITATION(S) 61057, 61223

61211 (Juel-Spez—108, pp 17-27) **Assessment of technical potential: problems, methods and results.** Obermair, G. (Univ. of Regensburg, Germany). Apr 1981. NTIS (US Sales Only), PC A06/MF A01.

From Meeting of experts of Annex III and IIIa integration of wind power into national electricity supply systems; Regensburg, F.R. Germany (29 Jan 1981).

The technical and economic assessment method for the integration of wind energy into the supply system is summarized. The natural potential, given by the stochastic wind field $v \rightarrow (r,t)$ over the total area is going through what may be called a technical filter to be reduced to the technical potential. The technical filter involves stability and control requirements (integrability), the efficiency of wind converters (production function) and the exclusion of technically unaccessable areas (usable area). The technical potential in turn is reduced to an economic potential by the economic filter which involves competitiveness from the individual investor's point of view, measured against other energy sources, comparative social costs and socio-economic preferences and the actual cost and existing use of land for wind energy parks.

61212 (Juel-Spez—108, pp 28-37) **Economic evaluation.** Hoffmann, L. (Univ. of Regensburg, Germany). Apr 1981. NTIS (US Sales Only), PC A06/MF A01.

From Meeting of experts of Annex III and IIIa integration of wind power into national electricity supply systems; Regensburg, F.R. Germany (29 Jan 1981).

The economic significance of wind energy to the Federal Republic of Germany is assessed in terms of: its potential contribution to the country's energy supply; its competitiveness vis-a-vis other energy sources; and its social desirability, measured by its contribution to the realization of general socio-economic goals. It is found that the technically feasible contribution of wind energy is about 220 TWh annually, and could make a significant contribution to the energy supply. Break-even-costs of investment are found to be in the range of current costs of investment. The kinds of costs considered in a social evaluation are listed. (LEW)

1705 Environmental Aspects

61213 **(RFP—3305) Safety data for small wind systems.** Bass, L.; Wynholds, H.; Bloedorn, J.; Weis, P.; Herzog, F. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Wynholds (Hans W.) Co., Cupertino, CA (USA)). Sep 1981. Contract AC04-76DP03533. 111p. NTIS, PC A06/MF A01. Order Number DE82015400.

Portions of document are illegible.

Adoption of voluntary consensus standards by an industry is an appropriate means to establish the minimum safety requirements of a product and to gain acceptability in the market place. Technical data and recommendations in the development of Small Wind Energy Conversion Systems (SWECS) safety standards are provided. A SWECS hazards analysis was prepared using system safety techniques. Hazards are identified, standards are proposed, and other appropriate actions are recommended to reduce the risk of personal injury or property damage.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 61208

61214 **(DOE/ARS—3707-20741/81/1) Darrieus wind-turbine and pump performance for low-lift irrigation pumping. Final report.** Hagen, L.J.; Sharif, M. (Kansas State Univ., Manhattan (USA)). Oct 1981. Contract AI01-76ET20319. 65p. NTIS, PC A04/MF A01. Order Number DE82016270.

In the Great Plains about 15 percent of the irrigation water pumped on farms comes from surface water sources; for the United States as a whole, the figure is about 22 percent. Because of forecast fuel shortages, there is a need to develop alternative energy sources such as wind power for surface water pumping. Specific objectives of this investigation were to: design and assemble a prototype wind-powered pumping system for low-lift (i.e., < 15 m head) irrigation pumping; determine performance of the prototype system; design and test an irrigation system using the wind-powered prototype in a farm application; and determine the size combinations of wind turbines, tailwater pits, and temporary storage reservoirs needed for successful farm application of wind-powered tailwater pumping systems in western Kansas. The power source selected was a two-bladed, 6-m-diameter, 9-m-tall Darrieus vertical-axis wind turbine with 0.10 solidity and 36.1 M^2 swept area.

61215 **(DOE/R5/10242—T1) Feasibility study of wind-generated electricity for rural applications in southwestern Ohio. Final technical report.** Kohring, G.W. (Kohring (Gene W.), Hamilton, OH (USA)). 1982. Contract FG02-80R510242. 29p. NTIS, PC A03/MF A01. Order Number DE82021596.

This study is designed to investigate the parameters associated with domestic production of wind generated electricity for direct use by small farms and rural homes in the southwestern Ohio region. The project involves direct utility interfaced electricity generation from a horizontal axis, down-wind, fixed pitch, wind powered induction generator system. Goals of the project are to determine: (1) the ability to produce useful amounts of domestic wind generated electricity in the southwestern Ohio region; (2) economic justification for domestic wind generated electrical production; and (3) the potential of domestic wind generated electricity for reducing dependence on non-renewable energy resources in the southwestern Ohio region.

61216 **(ISD—269) Static investigations of rotor blades under deadweight and during stationary operation. Final report.** Argyris, J.H.; Braun, K.A.; Kirchgaessner, B. (Stuttgart Univ. (TH) (Germany, F.R.)). 1980. 62p. NTIS, PC A04/MF A01.

Several rotorblades of a horizontal axis windmill are studied both nonoperating under deadweight, and under quasi-stationary loading with constant forces at rated operation, the blades of which have flap and lead-lag freedom as well as flap-pitch coupling. With a suitable mass distribution it is possible to reduce the blade bending moments in the flap direction drastically. The use of aircraft construction materials is considered. Carbon fiber reinforced plastic is the most suitable. Most of the blade models are investigated without lag hinge. The coning angle of rated operation assumed for the layout is reduced considerably for the blade models with lead-lag freedom in order to obtain sufficient centrifugal stiffness in the lag direction.

61217 **(ISD—270) Stability and response to gravity of the flap lag motion for a rigid rotor blade with flap-pitch coupling. Final report.** Argyris, J.H.; Kirchgaessner, B. (Stuttgart Univ. (TH) (Germany, F.R.)). 1980. 59p. NTIS, PC A04/MF A01.

Translated from ISD-244, 80p, 1979.

The coupled flap lag motion of a single, rigid rotor blade of a wind energy converter with flap and lag hinges and a coupling of the angle of attack with the flap motion is investigated. The equations of motion are developed under the assumption of linearized quasi-stationary aerodynamic forces. Static and dynamic stability of the coupled flap and lag motion are investigated. The equations are integrated for different cases under cyclic gravitational forces in order to estimate the importance of nonlinear terms and of the error resulting from the linearization of the conservative system. The nonlinear terms can be neglected, as can the effects of cyclic stiffness resulting from gravitational force. Results for nonlinearities arising from aerodynamic forces are inconclusive.

61218 **(ISD—271) Dynamic analysis of a rotor blade with flap and lag freedom and flap-pitch coupling. Final report.** Argyris, J.H.; Braun, K.A.; Kirchgaessner, B. (Stuttgart Univ. (TH) (Germany, F.R.)). 1980. 103p. NTIS, PC A06/MF A01.

Translated from ISD-258, 95p, 1979.

For a windmill rotor blade, a linearized system of differential equations of motion is developed, using a finite element idealization of linearized quasi-stationary aerodynamic forces. Constant rotational speed and a rigidly supported hub are assumed. For two rotor blade models, which differ only in their stiffness in lag direction, the complex eigenfrequencies are calculated. The dynamic response of the rotor blades is computed for cyclic gravity loads at rated operation, for a gust, and, in one case, for the tower wake. From the deformation of the structure the stresses at selected points along the blade are calculated. Torque and rotor thrust are determined for one model. Additional stiffness improves stability and lead-lag ancles. The coning angle is excellently stabilized by the flap-pitch coupling.

61219 **(ISD—272) Static and dynamic investigations for the model of a wind rotor. Final report.** Argyris, J.H.; Braun, K.A.; Kirchgaessner, B.; Walther, R. (Stuttgart Univ. (TH) (Germany, F.R.)). 1980. 71p. NTIS, PC A04/MF A01.

Translated from ISD-259, 69p, Jun 1979.

A wind rotor was constructed in order to test a data acquisition/transfer system which collects experimental data from the operating model and displays it on a screen. The comparison between the experimental data and the model results is used to check the applied computation methods. The static and dynamic analyses of the rotor model are considered. An 11% difference between experimental and model results is shown. A response problem with variable stiffness in time which arose during the dynamic analysis is solved by setting the structural stiffness constant over small time intervals, diagonalizing the time interval considered and integrating. After integration the solutions of the generalized degrees of freedom are transformed back into the physical system, using the time interval eigenvectors.

61220 **(ISD—273) Loading cycles and material data for the layout of a wind turbine of special hub concept. Final report.** Argyris, J.H.; Braun, K.A. (Stuttgart Univ. (TH) (Germany, F.R.)). 1980. 38p. NTIS, PC A03/MF A01.

Translated from ISD-260, 38p, Jun 1979.

The number of loading cycles of a rotor blade was estimated in order to assess allowable blade stress. Fatigue strengths and allowable stresses are calculated for aeronautic construction materials. Using wind data, the number of starts and stops was estimated. With a guess for the number of revolutions necessary to reach stationary operation from standstill, the number of loading cycles was determined, using the blade aerodynamics. The number of operational hours gives the number of loading cycles for rated operation. Rotation speeds of 1.67 and 2 rad/sec are considered. For 1.67, the number of loading cycles during stationary operation 2.06 x 10 to the 8th power during starts and cut offs 357,000. For 2 rad/sec, results are 2.47 x 10 to the 8th power and 463,000. Stress values, expressed in installed power/sqmm, are: aluminum alloy 98 stainless steel 294 glass fiber reinforced plastic 98 and carbon fiber reinforced plastic 147.

61221 **(ISD—274) Static and dynamic investigations of different towers for wind turbines. Final report.** Argyris, J.H.; Braun, K.A. (Stuttgart Univ. (TH) (Germany, F.R.)). 1980. 125p. NTIS, PC A06/MF A01.

The kinematics of a cantilevered, a conventional guyed, and a compliant (elastic column held by a rigid framework) tower were studied. The static layout of the towers is established, using the reactions due to different gusts which a two-bladed rotor (120 m diameter) imposes on a rigid support as external loads. The rotor blades are assumed to be inelastic. Each one has a flapping hinge and a flap-pitch coupling. Dynamic responses were calculated by the finite element method. The guyed tower is superior to the cantilevered one. A 10.4 deg inclination angle seems best for the compliant tower, but more dynamic and stability analyses are needed before undertaking further tower geometry optimization.

61222 **(ISD—275) Rotor model for the verification of computational methods. Final report.** Argyris, J.H.; Aicher, W.; Karl, F.; Kuemmerle, W.; Mueller, M. (Stuttgart Univ. (TH) (Germany, F.R.)). 1980. 66p. NTIS, PC A04/MF A01.

A windmill rotor model with 7.3 m rotor diameter was constructed in order to test a data acquisition/transmission system and computational models. Data, e.g., strains, angles, linear movements, accelerations, are measured at the rotor, digitized, and transmitted optoelectronically. Measurements of rotor blade dynamic response tc cyclic gravity loading are compared with theoretical values. Deviation between measurements and calculations is 11%.

61223 **(Juel-Spez—108) Implementing agreement for a programme of research and development on wind-energy-conversion systems.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Project Management for Energy Research (PLE)). Apr 1981. 107p. (CONF-810176—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82902575.

From Meeting of experts of Annex III and IIIa integration of wind power into national electricity supply systems; Regensburg, F.R. Germany (29 Jan 1981).

Portions of document are illegible.

Separate abstracts were prepared for 7 papers in this conference proceedings. The proceedings also includes one other paper about the possibility of eliminating strong oscillations of output power of a wind energy plant. (LEW)

61224 (Juel-Spez—108, pp 41-62) **Assessment of the potential of LWECS in the Netherlands.** Dub, W. (Univ. of Regensburg, Germany). Apr 1981. NTIS (US Sales Only), PC A06/MF A01.

In Implementing agreement for a programme of research and development on wind-energy-conversion systems.

Hourly mean wind speeds and directions at 4 sites and half-hourly wind speeds and directions at 1 site in the Netherlands were taken. The data are extrapolated by three different formulas whose

results are compared, and the monthly and annual mean wind speeds at 100 m are tabulated. Some technical basics of wind turbine design are reviewed, and wind energy production of a wind turbine is calculated and tabulated. Also given are the daily percentage of the total load that a compound system of 3-MW wind turbines would have met in 1975. The number of wind turbines required to meet the loads of various sites are given. (LEW)

61225 (Juel-Spez—108, pp 63-70) **Power fluctuations: technical and statistical aspects.** Pape, H. (Univ. of Regensburg, Germany). Apr 1981. NTIS (US Sales Only), PC A06/MF A01.

In Implementing agreement for a programme of research and development on wind-energy-conversion systems.

Wind power fluctuations which occur in a time range of minutes are dealth with. The double fed asynchronous generator permits a limited speed range and gives the turbine blade control time to respond to changing wind conditions, thus providing a much more regular power output than if the turbine is operated with a constant rotor speed. Remaining fluctuations must be regulated by the grid. Two regulation concepts are discussed. Statistical aspects for several turbines are considered. (LEW)

61226 (Juel-Spez—108, pp 71-80) **Forecasting wind power output.** Dub, W. (Univ. of Regensburg, Germany). Apr 1981. NTIS (US Sales Only), PC A06/MF A01.

In Implementing agreement for a programme of research and development on wind-energy-conversion systems.

Forecasting time periods which allow a reoptimization of the base, intermediate, and peak load wind power plants incorporated in a utility mix are discussed. It is found that, having a good estimator of the mean wind speed for a planning period, the mean wind power output will be underestimated as long as the wind speed is in the range between cut-in and rated speeds. (LEW)

61227 (Juel-Spez—108, pp 81-95) **Assured load carrying capability and capacity credit.** Pape, H. (Univ. of Regensburg, Germany). Apr 1981. NTIS (US Sales Only), PC A06/MF A01.

In Implementing agreement for a programme of research and development on wind-energy-conversion systems.

The terms available capacity, assured load carrying capability, capacity credit, equivalent firm capacity, effective load carrying capability, and mean value are defined and related to the operation of wind power plants. (LEW)

61228 (NASA-TM—82751) **Variable gain for a wind turbine pitch control. Final report.** Seidel, R.C.; Birchenough, A.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1981. 14p. NTIS, PC A02/MF A01.

The gain variation is made in the software logic of the pitch angle controller. The gain level is changed depending upon the level of power error. The control uses low gain for low pitch activity the majority of the time. If the power exceeds ten percent offset above rated, the gain is increased to a higher gain to more effectively limit power. A variable gain control functioned well in tests on the Mod-0 wind turbine.

61229 (NASA-TM—82761) **NASA Lewis large wind turbine program.** Thomas, R.L.; Baldwin, D.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. 24p. (CONF-811043—). NTIS, PC A01/MF A01.

From 5. biennial wind energy conference and workshop; Washington, DC, USA (5 Oct 1981).

The program is directed toward development of the technology for safe, reliable, environmentally acceptable large wind turbines that have the potential to generate a significant amount of electricity at costs competitive with conventional electric generation systems. In addition, these large wind turbines must be fully compatible with electric utility operations and interface requirements. Advances are made by gaining a better understanding of the system design drivers, improvements in the analytical design tools, verification of design methods with operating field data, and the incorporation of new technology and innovative designs. An overview of the program activities is presented and includes results from the first and second generation field machines (Mod-OA, -1, and -2), the design phase of the third generation wind turbine (Mod-5) and the advanced technology projects. Also included is the status of the Department of Interior WTS-4 machine.

61230 (PM—80-4) **Wind energy planning considerations.** Vansetten, A.; Voogd, H. (Technische Hogeschool Delft (Netherlands)). Apr 1980. 19p. (In Dutch). NTIS, PC A02/MF A01.

Windpowered utilization in the Netherlands and the search for wind rich areas is discussed. It is suggested that large water areas, like the North Sea and Market Lake, are the preferred areas for wind powered energy production. Storage of wind energy in large water basins is suggested. Government wind energy production programs like the installation of wind parks, and difficulties because of opposing local interests are discussed. Windmill exploration by small private industry, rather than by government administered programs, are outlined.

61231 (RFP—3291) **Enertech 2-kW high-reliability wind system. Phase II. Fabrication and testing.** Cordes, J.A.; Johnson, B.A. (Enertech, Norwich, VT (USA)). Jun 1981. Contract AC04-76DP03533. 75p. NTIS, PC A04/MF A01. Order Number DE82015122.

A high-reliability wind machine rated for 2 kW in a 9 m/s wind has been developed. Activities are summarized that are centered on the fabrication and testing of prototypes of the wind machine. The test results verified that the wind machine met the power output specification and that the variable-pitch rotor effectively controlled the rotor speed for wind speeds up to 50 mph. Three prototypes of the wind machine were shipped to the Rocky Flats test center in September through November of 1979. Work was also performed to reduce the start-up wind speed. The start-up wind speed to the Enertech facility has been reduced to 4.5 m/s.

61232 (RFP—3301) **ASI/Pinson 1-kW high-reliability wind system. Phase II. Prototype construction and testing.** Noll, R.B.; Drees, H.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Aerospace Systems, Inc., Burlington, MA (USA); Pinson Energy Corp., Marstons Mills, MA (USA)). Jul 1981. Contract AC04-76DP03533. 159p. NTIS, PC A08/MF A01. Order Number DE82021711.

The approved design is a 15-ft vertical-axis turbine with three straight 8-ft blades controlled by a tilt-cam mechanism. The tilt-cam mechanism controls blade cyclic pitch amplitudes in a manner similar to a helicopter swash plate. The turbine rotor has a calculated power coefficient of 0.4 at an optimum tip speed ratio of ~ 3.0 which results in a rotational speed of 112 RPM in a 9 m/sec wind. The electrical system provides 1-kW of 24 V DC power in a 9 m/sec wind by means of a flux-switching alternator. The electronic circuitry, designed with high-reliability components, consists of a voltage regulator and a power rectifier. A dumpload circuit is provided as an option. Two transient protection networks are included, one on the tower for the alternator and the other to protect circuitry in the control building. Three prototypes were fabricated and extensive testing was conducted on the first unit. Prototype tests showed that the SWECS operated as designed although output at 20 MPH was slightly lower than 1-kW. A system power coefficient of 0.25 was obtained in initial tests. Design changes were made as a result of tests, the most noticeable change being the replacement of the approved vertical tail vane and horizontal wing with a V-vane configuration. Poor wind conditions precluded completion of acceptance testing. As a result, Rockwell performed controlled velocity tests (CVT) of the first prototype prior to field tests. Additional effort included instrumentation for the first prototype; design, fabrication and testing of equipment for manual installation; and preparation of an assembly, operation and maintenance manual.

61233 **(RFP—3331/1) UTRC 15-kW wind-system development. Phase I. Design and analysis. Volume I. Executive summary.** Taylor, R.B.; Cheney, M.C. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; United Technologies Research Center, East Hartford, CT (USA)). Dec 1981. Contract AC04-76DP03533. 19p. NTIS, PC A02/MF A01. Order Number DE82021709.

The wind system consists of a horizontal-axis, two-bladed, down-wind rotor, which is free in yaw and is supported by a cantilevered free standing tower. Control of blade pitch is provided by a passive system consisting of pendulums which are sensitive to centrifugal forces created by rotor rotation. Rotor speed control in high winds is achieved by blade stall and the system is designed to withstand gusts up to 56 m/s. The design of the electrical system, head assembly, and nacelle and the tower design and erection are described briefly. Also discussed is the system analysis, consisting of predicted power output and annual energy capture, cost of energy, analysis of loads and stresses, availability, and safety. Experimental tests were performed in support of the design in the areas of materials evaluation and component testing. (LEW)

61234 **(RFP—3331/2) UTRC 15-kW wind-system development. Phase I. Design and analysis. Volume II. Technical report.** Taylor, R.B.; Cheney, M.C. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; United Technologies Research Center, East Hartford, CT (USA)). Dec 1981. Contract AC04-76DP03533. 181p. NTIS, PC A09/MF A01. Order Number DE82021710.

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A description is given of the design of a 15-kW wind turbine. The wind turbine employs the UTRC Composite Bearingless Rotor Concept in conjunction with a passive pendulum control system which controls blade pitch for start-up, efficient power generation, and high-speed survivability. Also included is a summary of experimental material and component tests which were performed in support of the wind turbine design. Studies of system reliability, maintainability, availability and safety are reported and an estimate of the cost-of-energy is also made for a production wind system.

61235 **(RFP—3339) Wind systems technical notes: 1979-1980.** Stafford, J.V. (ed.). (Rockwell International Corp., Golden, CO (USA). Energy Systems Group). Feb 1982. Contract AC04-76DP03533. 198p. NTIS, PC A09/MF A01. Order Number DE82016358.

Portions of document are illegible.

This report contains 13 Technical Notes produced by the Rocky Flats Wind Systems Program in 1979-1980 to document specialized tests of small wind systems and other investigations. Subjects include: vibration, dynamometer, and controlled velocity tests of 1 to 2 kW and 8 kW prototype wind systems; the use of induction generators; data collection and reporting procedures; analog-to-digital data conversion; optical rpm sensors; alternator frequency monitoring; and air density adjustments. A separate abstract was prepared for each of the technical notes.

61236 **(SERI/SP—19136-4) Wind energy conversion system analysis model (WECSAM) computer program documentation.** Downey, W.T.; Hendrick, P.L. (Little (Arthur D.), Inc., Cambridge, MA (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1982. Contract AC02-77CH00178. 78p. NTIS, PC A05/MF A01. Order Number DE82021014.

Portions of document are illegible.

Described is a computer-based wind energy conversion system analysis model (WECSAM) developed to predict the technical and economic performance of wind energy conversion systems (WECS). The model is written in CDC FORTRAN V. The version described accesses a data base containing wind resource data, application loads, WECS performance characteristics, utility rates, state taxes, and state subsidies for a six state region (Minnesota, Michigan, Wisconsin, Illinois, Ohio, and Indiana). The model is designed for analysis at the county level. The computer model includes a technical performance module and an economic evaluation module. The modules can be run separately or together. The model can be run for any single user-selected county within the region or looped automatically through all counties within the region. In addition, the model has a restart capability that allows the user to modify any data-base value written to a scratch file prior to the technical or economic evaluation. Thus, any user-supplied data for WECS performance, application load, utility rates, or wind resource may be entered into the scratch file to override the default data-base value. After the model and the inputs required from the user and derived from the data base are described, the model output and the various output options that can be exercised by the user are detailed. The general operation is set forth and suggestions are made for efficient modes of operation. Sample listings of various input, output, and data-base files are appended. (LEW)

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 60775, 60802, 61588, 61590, 61592, 61624

61237 **(ANL/EES-TM—185) Assessment of the existing data bases for industrial boilers.** Placet, M. (Teknekron Research, Inc., McLean, VA (USA)). Sep 1981. Contract W-31-109-ENG-38. 92p. NTIS, PC A05/MF A01. Order Number DE82021185.

Portions of document are illegible.

This report examines the accuracy and completeness of the existing data bases related to the industrial boiler population. The study consists of a review of EPA's National Emissions Data System (NEDS), the Major Fuel Burning Installation (MFBI) data base maintained by DOE, and several published studies that attempted to fill in information missing from NEDS and MFBI. Erroneous, missing and inconsistent data elements in both MFBI and NEDS are investigated, and the information in the two data bases is compared on a boiler-by-boiler basis. Emphasis is placed on determining if the size and capacity factor distributions developed in various analyses using NEDS, MFBI, and other sources are reasonable. The size/capacity factor distribution in the Industrial Fuel Choice Analysis Model (IFCAM), a model used to project industrial fuel choice and pollution trends, is also examined.

61238 **(CW-WR—76-020.80A) High-Temperature-Turbine-Technology Program. Phase II. Technology test and support studies. Technical progress report, 1 January-31 March 1981.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). May 1981. Contract AC01-76ET10348. 65p. (FE—2291-80A1). NTIS, PC A04/MF A01. Order Number DE81028443.

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This report presents the status of work performed on the High Temperature Turbine Technology Program, Phase II Technology Test and Support Studies during the first quarter of 1981, January 1 through March 31, 1981. Work is in progress to prepare the Turbine Spool Technology Rig (TSTR) for a 100 h test with contaminated fuel. The 60° Sector TSTR Combustor Rig is being prepared for test to verify the contaminant injection system operation and its effect on the exit temperature profile. This information will be used to modify the TSTR combustor prior to test. The status of the combustor development is given for (a) LBG Combustor (Fuel Cooled) and (b) High Temperature Low Emissions Combustor for coal-derived liquid fuel. Both of these combustors are in the design stage. Control systems status and descriptions for the above items are given. The analytical studies to support the combustor programs are described. Oxidation testing of Nichrome V-Cb material porous mesh for transpiration air cooled turbine airfoils is reviewed.

61239 **(DOE/ER—0130) Projections of cost and on-site manual-labor requirements for constructing electric-generating plants, 1980-1990.** (Department of Energy, Washington, DC (USA). Office of Energy Research; Department of Labor, Washington, DC (USA). Construction Labor Demand System). Feb 1982. 112p. (DOL/CLDS/PP—3). NTIS, PC A06/MF A01. Order Number DE82016020.

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This report represents part of a continuing effort by the Federal Government to forecast the capital and labor required for constructing electric generating capacity additions necessary to accommodate projected economic and population growth in the US and its regions. Information is included on anticipated additions to electric generating capacity, labor requirements for these additions, capital cost requirements, and forecasting models. Coal-fired, nuclear, hydro, and pumped storage power plants are considered in these forecasts. (LCL)

61240 **(DOE/ET/15490—T14) Electrostatic Granular-Bed-Filter Development Program. Quarterly technical report, January-March 1982.** (General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.). Apr 1982. Contract AC21-79ET15490. 6p. (FE—5490-35). NTIS, PC A02/MF A01. Order Number DE82019080.

This contract provides for laboratory experiments and analyses to develop electrostatic granular bed (EGB) filtration for Pressurized Fluidized Bed (PFB) combined cycle application. These experiments will provide the data necessary to design a hot test model and to perform systems integration and economic evaluation studies. Based on the laboratory results, preliminary engineering estimates of the capital and operating costs will be provided for the selected approach. In parallel with the electrostatic granular bed filter testing, laboratory scale experiments and engineering assessments will be performed for two concepts for removing corrosive alkali metal vapor from the combustion gases. During this quater, granular bed media candidates, alumina, glacial basaltic stone, and bauxite, were tested in the EGB thermal and mechanical environment in order to identify a material which would resist fracture under PFB operating conditions. The tests at 1400°F operating temperature are described. Due to the excellent wear resistance of the bauxite, its relatively low price ($0.70/lb) as compared with alumina (approx. $3/lb) and its chemical purity compare to the natural basaltic stone, bauxite is now considered the prime material candidate for a retest of the EGB-AFB filter at the Morgantown test facility. (LCL)

61241 **(DOE/FE/15067—3) Conceptual IGCC power-plant design. Third quarter progress report, Fiscal Year 1982, April 1-June 30, 1982.** Lemezis, S. (Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). 26 Jul 1982. Contract AC21-81FE15067. 23p. NTIS, PC A02/MF A01. Order Number DE82021188.

The Roy S. Nelson power plant near Lake Charles, LA contains 5 units fueled by natural gas or oil plus a recently dedicated coal-fired Unit No. 6. Further use of coal as a fuel can be achieved through the successful application of combustion turbine refueling and coal gasification repowering in conjunction with existing installations. Installation of a Westinghouse combustion turbine and electric generator, nominally rated at 100 MW to be known as Nelson No. 7, is now under way. The turbine, initially designed to use natural gas and distillate oil, will have the capability to use synthetic gas derived via coal gasification as a fuel. The combustion turbine has been installed as a simple-cycle machine. This contract specifically concerns examining the economic and technical feasibility of converting Unit 7 to combined cycle operation by the addition of a waste heat recovery unit, which could furnish additional energy to improve the performance of one or more existing steam turbine-generator units at Nelson Station. Principal activities this third quarter of contract performance concerned: substantial revision of preliminary calculated overall performance to reflect equipment and operating judgements made early in the design process; completing technical evaluation of the alternate schemes, whereby the gasification addition can be integrated with the entire Nelson Station to form a viable IGCC power plant; design of equipment required for the numerous subsystems in the Nelson Plant addition; and beginning work on cost estimation, reliability and environmental permitting analyses.

61242 **(EPRI-AP—2518) Materials for syngas coolers. Final report.** Perkins, R.A.; Morse, G.; Coons, W.C. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). Aug 1982. 187p. NTIS, PC A09/MF A01. Order Number DE82906452.

The objective of this project is to provide a technical basis for materials selection and laboratory testing of practical boiler tube materials which will provide reliable long term service in syngas coolers for coal gasification combined cycle power plants. The resistance of low alloy steel, stainless steels, and aluminum-rich coatings to attack by a high sulfur, medium Btu coal gasification atmosphere has been evaluated at 300 to 500°C. Samples were heated in mixtures representative of the product gas from entrained slagging gasifiers in laboratory furnaces for 1500 to 3000 hr. Iron sulfide scale formed rapidly on low alloy steels with estimated surface recession rates of 20 to 120 mil/y at 300 to 500°C. Pack aluminized (alonized), chromized, and thermal sprayed aluminum were indicated to be effective protective coatings for these materials. Medium chrome (11%) stainless steels (409SS) formed thick sulfide-oxide scales with estimated recession rates of 35 to 50 mil/y at 400 to 500°C. High Cr (>23%) ferritic and austenitic stainless steels (Ebrite 26-1, 309SS, 310SS, HK40)FeCrA1Y, and titanium had the best resistance to attack with estimated recession rates of <0.15 mil/y. These materials may have adequate resistance for long time service in radiant coolers operating up to 500°C on high sulfur medium Btu gas. Performance is analyzed in terms of thermodynamic and kinetic considerations, and recommendations for long term tests and development of protective coatings are presented.

61243 **(EPRI-AP—2536) Reliability and availability assessments of selected domestic combined-cycle power-generating plants. Final report.** Brown, H.W.; Gardner, N.J. (Arinc Research Corp., Annapolis, MD (USA)). Aug 1982. 104p. NTIS, PC A06/MF A01. Order Number DE82905494.

This report presents the results of reliability and availability assessments performed with the cooperation of seven utilities operating combined-cycle power plants in service since 1974 to evaluate: combined-cycle unit equivalent availability and equivalent forced outage rates; system and component mean time between failures (MTBF) and mean downtime (MDT); and gas turbine reliability correlations with service hours, starting frequency, fuel type, and service factor. A data base was developed for 45 plant components or systems for the period 1978 through 1980; this led to recommendations for improving outage data collection for the purpose of reliability analysis. In addition reliability, availability, and maintainability prediction models for several commercial combined-cycle plant designs were developed and validated.

61244 **(EPRI-AP—2554) Investigation of methanol as a boiler fuel for electric-power generation. Final report.** Weir, A. Jr.; von KleinSmid, W.H.; Danko, E.A.; Kertamus, N.J. (Southern California Edison Co., Rosemead (USA)). Aug 1982. 208p. NTIS, PC A10/MF A01. Order Number DE82905495.

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A series of combustion tests were made with methanol in a 44.5 MW power boiler to evaluate gaseous emissions and boiler performance. Parallel combustion tests with fuel oil and natural gas provided a basis for comparing the results. Approximately 406,000 gallons of methanol were burned in Boiler 4 of Southern California Edison's Highgrove Generating Station, located in Grand Terrace, California, from February 17 to May 15, 1981. Methanol proved to be an acceptable fuel in terms of its handling and firing characteristics. The slightly higher heat rate and limited derating were judged to be minor disadvantages in the use of methanol. In fact, the derating with methanol was unique with the balanced draft boiler as tested. A striking reduction in the NO/sub x/ emissions of nearly 60% was observed compared to fuel oil and natural gas. The addition of water to methanol caused an additional reduction of NO/sub x/. At present, the use of methanol is not practical in the utility industry. Reliable quantities of methanol, at prices competitive with the costs of conventional fuel, are not currently available.

61245 **(EPRI-EM—2485) Cool-Storage Instrumentation and Data-Verification Program. Final report.** Bullock, C.E.; Reedy, W.R. (Carrier Corp., Syracuse, NY (USA). Research Div.). Jul 1982. 344p. NTIS, PC A15/MF A01. Order Number DE82905803.

Heating and cooling equipment appears to offer a large potential for utilization of off-peak electrical power. The use of cool storage to provide summer space conditioning would be one method of utilizing off-peak power and providing summer peaking electric utilities with the benefits of lowered summer daily load

profiles, and attendant reduction in the cost of electricity. This report presents the results of a residential cool storage instrumentation and data verification program, sponsored by the Electric Power Research Institute. The purpose of the program was to gather quantitative field performance data on operating systems and develop guidelines for the use and application of cool storage systems. More specifically, the results presented herein are intended to provide the electric utility industry with data to aid in the evaluation of cool storage impacts on utility load factors, revenues, operating costs, and capacity requirements. R and D needs and opportunities are also identified. Program tasks included the monitoring and analysis of eighteen utility-sponsored cool storage experiments, development of mathematical models required for a rigorous analytical evaluation, and the conduct of parameter studies. Results of the field monitoring and analytical studies indicate that cool storage can be an effective means of shifting electrical load. The results further indicate that the required refrigeration condensing unit capacity can be smaller than would be required for a conventional air conditioning system.

61246 **(ITA—82-06-504) Electric power equipment - Paraguay. Foreign market survey report.** Ceuppens, H.D. (International Trade Administration, Washington, DC (USA)). Mar 1982. 36p. NTIS PC $15.00/MF A01.

The market research was undertaken to study the present and potential US share of the market in Paraguay for electric power equipment; to examine growth trends in Paraguayan end-user industries over the next few years; to identify specific project categories that offer the most promising export potential for US companies; and to provide basic data which will assist US suppliers in determining current and potential sales and marketing opportunities. The trade promotional and marketing techniques which are likely to succeed in Paraguay were also reviewed.

61247 **(NASA-TP—1954) New features and applications of PRESTO, a computer code for the performance of regenerative, superheated steam turbine cycles.** Choo, Y.K.; Staiger, P.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jan 1982. 39p. NTIS, PC A03/MF A01.

The code was designed to analyze performance at valves-wide-open design flow. The code can model conventional steam cycles as well as cycles that include such special features as process steam extraction and induction and feedwater heating by external heat sources. Convenience features and extensions to the special features were incorporated into the PRESTO code. The features are described, and detailed examples illustrating the use of both the original and the special features are given.

61248 **(ORNL/TM—8146) User's manual for the INDCEPT code for estimating industrial steam boiler plant capital investment costs.** Bowers, H.I.; Fuller, L.C.; Hudson, C.R. II. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 63p. NTIS, PC A04/MF A01. Order Number DE82021111.

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The INDCEPT computer code package was developed to provide conceptual capital investment cost estimates for single- and multiple-unit industrial steam boiler plants. Cost estimates can be made as a function of boiler type, size, location, and date of initial operation. The output includes a detailed breakdown of the estimate into direct and indirect costs. Boiler plant cost models are provided to reflect various types and sources of coal and alternate means of sulfur and particulate removal. Cost models are also included for low-Btu and medium-Btu gas produced in coal gasification plants.

61249 **(PNL—4043) Experimental evaluation of dry/wet air-cooled heat exchangers. Progress report.** Hauser, S.G.; Gruel, R.L.; Huenefeld, J.C.; Eschbach, E.J.; Johnson, B.M.; Kreid, D.K. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1982. Contract AC06-76RL01830. 135p. NTIS, PC A07/MF A01. Order Number DE83000397.

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The ultimate goal of this project was to contribute to the development of improved cooling facilities for power plants. Specifically, the objective during FY-81 was to experimentally determine the thermal performance and operating characteristics of an air-cooled heat exchanger surface manufactured by the Unifin Company. The performance of the spiral-wound finned tube surface (Unifin) was compared with two inherently different platefin surfaces (one developed by the Trane Co. and the other developed by the HOETERV Institute) which were previously tested as a part of the same continuing program. Under dry operation the heat transfer per unit frontal area per unit inlet temperature difference (ITD) of the Unifin surface was 10% to 20% below that of the other two surfaces at low fan power levels. At high fan power levels, the performances of the Unifin and Trane surfaces were essentially the same, and 25% higher than the HOETERV surface. The design of the Unifin surface caused a significantly larger air-side pressure drop through the heat exchanger both in dry and deluge operation. Generally higher overall heat transfer coefficients were calculated for the Unifin surface under deluged operation. They ranged from 2.0 to 3.5 Btu/hr-ft^2-°F as compared to less than 2.0 Btu hr-ft^2-°F for the Trane and HOETERV surfaces under similar conditions. The heat transfer enhancement due to the evaporative cooling effect was also measureably higher with the Unifin surface as compared to the Trane surface. This can be primarily attributed to the better wetting characteristics of the Unifin surface. If the thermal performance of the surfaces are compared at equal face velocities, the Unifin surface is as much as 35% better. This method of comparison accounts for the wetting characteristics while neglecting the effect of pressure drop. Alternatively the surfaces when compared at equal pressure drop essentially the same thermal performance.

61250 **(SAND—82-8235) Conceptual design report of a refuse-fired steam plant.** Bedinger, L.B. (Sandia National Labs., Livermore, CA (USA)). Aug 1982. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01. Order Number DE82021074.

This is a conceptual design report for the installation of a refuse-fired boiler to produce steam. The refuse, mostly paper waste, would come from two adjacent facilities, Sandia National Laboratories, Livermore and Lawrence Livermore National Laboratory. The new steam plant, to be located at SNLL, would produce close to 100% of the steam requirements at SNLL. Unfortunately it does not have an attractive payback.

61251 **Economics of steam turbine use in industry.** Viar, W.L. (Waterland, Viar and Associates, Inc., Wilmington, DE). *American Institute of Industrial Engineers, Detroit Chapter, Proceedings of the Annual Conference;* 67-72(1981). (CONF-810538—). Detroit, MI, USA (17 May 1981).

Steam turbines exert strong influence in the operation of industrial steam systems. The proper application of turbines is a function of economics, not of long-standing preferences for them or their alternative drivers, such as motors or engines. In industrial plants, turbines must supply valid process heat loads through extraction and exhaust flows. This will maximize the production of low cost shaft work with least effects on the environment. Optimum use of fuel resources occurs only when the availability of energy is persistently preserved in its transformation and utilization in industry. Technical and economic aspects of turbine applications based on field experiences are presented. Diagrams illustrate specific concepts and advantages of systems which are discussed.

61252 **Cogeneration: a concept for today.** Ross, J.R. (Univ. of Tennessee, Cookeville, TN). *American Institute of Industrial Engineers, Detroit Chapter, Proceedings of the Annual Conference;* 582-587(1981). (CONF-810538—). Detroit, MI, USA (17 May 1981).

The cogeneration concept applies to practices which utilize waste heat, steam, waste materials or equipment for multiple energy conversions including electric power generation. The broad field of cogeneration and associated economic and qualitative benefits are defined, and some specific applications are indicated. Steps for deciding if cogeneration would benefit your company are listed. A case history of a successful small scale cogeneration project is detailed to demonstrate the feasibility of cogeneration principles for today's small or medium size industrial plant.

61253 **Power condenser heat transfer technology. Computer modeling/design/fouling.** Marto, P.J.; Nunn, R.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1981). 498p. Hemisphere Publishing Corp., Washington, DC.

Twenty-one papers are presented in this book. A separate abstract was prepared for each of 9 papers. The remaining 12 papers were not in scope for the data base. (LCL)

61254 **Potential problem areas in simulating condenser performance.** Brickell, G.M. (GEC Power Engineering Ltd., Leicester, England). pp 51-61 of Power condenser heat transfer technology. Computer modeling/design/fouling. Marto, P.J.; Nunn, R.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1981).

The experimental background to present day computational methods is emphasized and several problem areas in performance prediction are discussed. It is concluded that existing methods, although satisfactory, require further development in order to accommodate certain three dimensional flow features and more experimental data is required to model important condensate transport effects.

61255 **Heat rejection system optimization.** Vrable, D.L. (General Atomic Co., San Diego, CA). pp 63-73 of Power condenser heat transfer technology. Computer modeling/design/fouling. Marto, P.J.; Nunn, R.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1981).

Selection of the design parameters for land based power plant surface condensers should consider both the details of the condenser design as well as the impact of these parameters on the remainder of the heat rejection system (cooling towers, pumps, piping). The condenser parameters such as the condensation temperature, cooling water inlet temperature and rise, flowrate, and pressure drops (steam-side and cooling water-side) affect both the overall plant performance and total cost. The large number of parametric combinations associated with the design of surface condensers as well as the interrelationship among the remainder of the heat rejection system components demands utilization of the computer to aid the condenser designer in the selection of the design parameters. The focus in this paper is to present the methodology in the condenser parameter selection that is based on optimization of the entire heat rejection system as a design entity. An example is presented to illustrate the results of a total heat rejection optimization study.

61256 **Modeling of the gas/vapor phase flow.** Butterworth, D. (Heat Transfer and Fluid Flow Service (HTFS), AERE Harwell, Oxon, England). pp 75-81 of Power condenser heat transfer technology. Computer modeling/design/fouling. Marto, P.J.; Nunn, R.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1981).

The gas/vapor phase flow modelling equation, as it applies to flow past condenser tube bundles is examined to determine if the terms in the equation are correct, if any important terms are missing, and if it is correct to restrict the analysis to two dimensions. The equation terms dealing with tube resistance, inertia, viscosity and axial flow are discussed. It is concluded that the treatment of tube bundles as anisotropic porous media is clearly an extremely powerful technique. There are still, however, very many questions regarding the correct form of equations to use in this method. This is a comparatively new field of study and there is tremendous scope for novel theoretical and experimental research in order to test and extend the current equations. (LCL)

61257 **Vapor shear and condensate inundation: an overview.** Fujii, T. (Kyushu Univ., Fukuoka, Japan). pp 193-223 of Power condenser heat transfer technology. Computer modeling/design/fouling. Marto, P.J.; Nunn, R.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1981).

Basic studies on the effects of vapor velocity, presence of air and condensate inundation upon condensation of steam on a horizontal tube are reviewed. For tubes without inundation the mathematical techniques are remarkably advanced as far as the heat-transfer coefficient is concerned, while the accuracy of experimental results is not so high as that of theoretical ones. Although a clue to qualitative prediction of the combined effect of vapor velocity and inundation is obtained, the observation of condensation phenomena in tube banks suggests that a few problems still remain to be studied for practical application.

61258 **Combined effects of vapor shear and inundation in tube bundles.** Eissenberg, D.M. (Oak Ridge National Lab., TN). pp 225-227 of Power condenser heat transfer technology. Computer modeling/design/fouling. Marto, P.J.; Nunn, R.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1981).

The combined effects of vapor shear and inundation on the condensate film heat transfer coefficient (HTC) for cylindrical horizontal tubes within tube bundles is discussed by first considering a single isolated tube and then tube bundles. It is concluded that there is a significant increase in condensate film HTC within tube bundles which results from vapor shear, and that vapor shear influences the inundation effect in tube bundles in two ways. It acts (as it does with a single tube) to thin the condensate film by accelerating the condensate in the direction of the vapor flow. This, of course, works in reverse with vapor upflow. Secondly, it affects the flow path of the condensate falling vertically from tube to tube. With horizontal cross flow, for example, vapor shear has been shown to transport condensate laterally, leaving high vapor shear regions with a reduced condensate load. Vapor shear may also promote side drainage by deflecting condensate from its normal vertical flow. In the case of vapor upflow, it can cause the bundle to flood if the steam velocity is sufficiently high, although the velocity necessary to cause this effect is probably unacceptable due to high pressure drop losses.

61259 **Use of enhanced surface geometries in condensers: an overview.** Webb, R.L. (Pennsylvania State Univ., University Park). pp 287-324 of Power condenser heat transfer technology. Computer modeling/design/fouling. Marto, P.J.; Nunn, R.H. (eds.). Washington, DC; Hemisphere Publishing Corp. (1981).

The use of enhanced surface geometries to improve the design of condensers is discussed. The survey includes both condensing and coolant-side enhancement. The possibilities considered include information from the technical and US Patent literature. The condensation section emphasizes film condensation. Enhanced condensation is considered for the following geometries: On the outer surface of horizontal and vertical tubes, forced condensation inside tubes and in plate-fin channels. The merits of the several competing techniques are discussed in attempt to identify those of greatest potential. The survey concludes with consideration of doubly enhanced tubes, which provide enhancement on the condensing and coolant sides. Commercially available enhancements are noted.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 60719, 60774, 60775, 60777, 60778, 60779, 60780, 60781, 60782, 60783, 60784, 60785, 60786, 60787, 60788, 60789, 60790, 60791, 60792, 60794, 60801, 60824, 60834, 61240, 61244, 62055

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 62179

61260 **(DOE/RA/03395—T1-Vol.1) Control of multiterminal HVDC systems embedded in ac networks. Volume I. Methodologies for control system design.** Hauth, R.L.; Nozari, F.; Winkelman, J.R.; Athans, M.; Chan, S.M. (General Electric Co., Schenectady, NY (USA); Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Information and Decision Systems). 28 May 1982. Contract AC01-78RA03395. 191p. NTIS, PC A09/MF A01. Order Number DE82021168.

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The goal of this research project was to develop control concepts applicable to future multiterminal high voltage dc (MTDC) networks embedded in bulk power ac systems. The con-

trols' objectives are to enhance the steady state and/or dynamic performance of the integrated MTDC/ac power system. A multiterminal HVdc system is one with more than two converter terminals. The three basic control levels of an MTDC system are: primary control, supplementary power modulation (damping) controls, and dispatch control. This report describes novel techniques for use in all three levels of control. The project also included basic research into the application of modern control robustness theories to the MTDC power modulation control design methodology.

61261 **(DOE/RA/03395—T1-Vol.2) Control of multiterminal HVDC systems embedded in ac networks. Volume II. Robustness of multivariable control systems.** Athans, M.; Lee, W.H.; Lehtomaki, N.A.; Levy, B.C.; Ng, P.T.P. (General Electric Co., Schenectady, NY (USA); Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Information and Decision Systems). 28 May 1982. Contract AC01-78RA03395. 115p. NTIS, PC A06/MF A01. Order Number DE82021167.

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The robustness of the stability of multivariable linear time-invariant feedback control systems with respect to model uncertainty is considered using frequency domain criteria. Available and new robustness tests are unified under a common framework based on the nature and structure of model errors. These results are derived using a multivariable version of Nyquist's stability theorem in which the minimum singular value of the return difference transfer matrix is shown to be the multivariable generalization of the distance to the critical point of a single-input, single-output (SISO) Nyquist diagram. Using the return difference transfer matrix a very general robustness theorem is presented from which all of the robustness tests dealing with specific model errors may be derived. These latter robustness tests regarding the stability of the feedback system under model variations may be divided into two categories: (a) those that use only the magnitude of the model error and (b) those that use some aspect of the model error structure, in addition to its magnitude. The robustness tests that explicity utilize model error structure are better able to guarantee feedback system stability in the face of model errors of large magnitude than those robustness tests that do not utilize model error structure and thus represent an improvement of these latter robustness tests. The robustness of Linear-Quadratic-Gaussian (LQG) control systems are analyzed via this robustness theory and multiloop stability margins are presented; in particular, a new type of margin, a cross-feed margin, is introduced. Other frequency domain analysis and design techniques are also briefly discussed and their relation to the present robustness analysis is examined. In addition a Linear-Quadratic based design procedure that guarantees a prescribed degree of stability is developed, with special emphasis upon its robustness properties.

61262 **(EPRI-EL—2532) Calibration of power-system-simulation programs using disturbance data. Final report.** Podmore, R.; Krzyzanowski, E. (ESCA Corp., Bellevue, WA (USA)). Aug 1982. 247p. NTIS, PC A11/MF A01. Order Number DE82906481.

The calibration of transient stability and long-term dynamic simulation programs is a concern to electric utilities because the results of these programs play a more important role in power system engineering studies. One of the most effective ways of validating a transient stability or long-term dynamic simulation program is to compare its performance with data that are recorded during a major system disturbance. This report describes past practices, ongoing developments, and future developments in this area. Seven past attempts at simulating major system disturbances with transient stability and long-term dynamic simulation programs are reviewed to assess their capabilities and limitations. Models for representing disturbance behavior of various system components, including generators, loads, transformers, turbines, and boilers, are reviewed, and needs for additional development are identified. Procedures that have been used for recording long-term dynamic response of variables for power plants, generators, loads, and the network are reviewed. Areas where the capabilities of modern energy control centers and data acquisition systems can be extended to enhance the task of calibrating a long-term dynamic simulation program are identified. Devices that have been used for recording power system synchronizing oscillations and past procedures for validating transient stability programs are also reviewed. The review encompasses the capabilities of devices, such as oscillographs, that have been traditionally available as well as several modern special-purpose units that digitally record voltage, current, megawatt, megavar, and frequency oscillations.

61263 **(EPRI-EL—2549) Effect of distributed power systems on customer-service reliability.** Ma, F.S.; Patmore, J.W.; Sidenblad, K.M. (Systems Control, Inc., Palo Alto, CA (USA)). Aug 1982. 98p. NTIS, PC A05/MF A01. Order Number DE82906478.

The objective of this study was to determine how distributed power systems (DPSs), particularly those driven by solar and wind energy, affect service reliability. The study shows that conventional reliability analysis methods can be extended to handle DPSs. A variety of methods was considered, ranging from an exponential approximation suitable for rough hand calculations to sophisticated statistical methods suitable for computer analysis. It was found that many of the questions relating to DPS reliability derive from a paucity of data rather than a deficiency in analytic methods. In particular, data on the temporal and spatial correlation of fluctuating resources are needed.

61264 **(EPRI-EL—2563) Flexible gas-insulated metal-enclosed transmission-system design. Final report.** Kroon, P.J.; Netzel, P.C.; Ponder, J.Z.; Spencer, E.M. (Brown Boveri Electric, Inc., Colmar, PA (USA)). Aug 1982. 139p. NTIS, PC A04/MF A01. Order Number DE82906476.

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This report describes the successful development of flexible gas-insulated cable for power transmission applications from 138 to 345 kV; culminating in the manufacture, test, and shipment of an 80-meter prototype 345-kV 1000-MVA cable to Waltz Mill for long term testing. The use of corrugated aluminum for the conductor and sheath permits a bend radius of 8.5 times the cable radius to allow reeling of the cable for shipment of long lengths by truck or rail. The successful installation and test of an earlier prototype cable at Waltz Mill is described. A machine to continuously produce corrugated-tubing was designed, fabricated and installed in its own building to serve as the basic tool with which to develop methods to permit continuous production of cable. A two-piece injection-molded insulating spacer was developed to permit continuous economical cable production. Numerous tests have demonstrated the outstanding dielectric properties of the basic material and the insulator design. A series of tables and graphs is presented to facilitate determination of current carrying capacity under various conditions for above-ground and underground installations. Continued effort is recommended to extend the technology to 500 kV with further improvements in the manufacturing process, leading to a demonstration project with the installation and operation of a 3-phase flexible SF_6 power transmission cable.

61265 **(UCID—19460) Technical-evaluation report on the adequacy of station electric-distribution-system voltages for the Prairie Island Nuclear Generating Plant, Units 1 and 2. (Docket Nos. 50-282, 50-306).** Selan, J.C. (Lawrence Livermore National Lab., CA (USA)). 17 Sep 1982. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01. Order Number DE82021013.

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This report documents the technical evaluation of the adequacy of the station electric distribution system voltages for the Prairie Island Nuclear Generating Plant, Units 1 and 2. The evaluation is to determine if the onsite distribution system in conjunction with the offsite power sources has sufficient capacity to automatically start and operate all Class 1E loads within the equipment voltage ratings under certain conditions established by the Nuclear Regulatory Commission. The evaluation finds that with some minor transformer loading modifications, hardware changes and the results of equipment testing and manufacturer data, the offsite sources were demonstrated to supply adequate voltage to the Class 1E equipment under worst case conditions.

61266 **Fault protection for high-current distribution.** Hopkinson, J.; Porter, J. *EPRI (Electric Power Research Institute) Journal;* 7: No. 6, 14-17(Jul 1982).

Efforts to protect electrical circuits from fault currents led to a new device, the current limiting protector (CLP), which combines a copper-bar solid conductor in parallel with a conventional silver and current-limited fuse within a 28 x 7-inch fiberglass cylinder. A fault current causes chemical reactions in the copper bar and diverts current into the conventional fuse, which melts and safely interrupts the fault current. Successful short-circuit tests of the CLP indicate substantial first-cost and operating-cost savings. 1 figure. (DCK)

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 61529, 61534

61267 (NUREG/CP—0031-Vol.1) **CSNI specialist meeting on operator training and qualifications.** (Institute of Nuclear Power Operations, Atlanta, GA (USA); Nuclear Regulatory Commission, Washington, DC (USA); Nuclear Energy Agency, 75 - Paris (France). Committee on the Safety of Nuclear Installations). Jun 1982. 370p. (CONF-8110148—Vol.1; CSNI—63-Vol.1). NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The events during the accident at TMI-2, along with others identified in retrospect at other nuclear plants, re-emphasized the critical role of the reactor operator. Many countries are focusing greater attention on the capabilities of control room operating staff and on the problems they face. In view of the importance to safety on the subject, the CSNI Subcommittee on Licensing decided that a specialist meeting should be held on the broad aspects of operator selection and training and the functions and organization of operating staff. The meeting focused on the functions, role and organization of control room personnel as a crew and as individuals; selection and qualifications of personnel; operator training and requalification; evaluation of crew and individual performance; professional and career alternatives for control room personnel; and concepts for the future (e.g., implementation and impact of computer technology, advanced simulator concepts, off-site monitoring and support). Fourteen countries and three international organizations were represented. This report consists of two volumes. Separate abstracts are included for each of the papers presented.

61268 (NUREG/CP—0031-Vol.1, pp 77-102) **Picket engineer concept in Swiss nuclear power plants.** Steffen, W. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

Switzerland has four plants already in operation, three of the 300 MW Class and one of 1000 MW, with a further 1000 MW plant under construction. Nuclear energy is of vital importance to the country, in 1980 it accounted for almost 30% of the year's total electricity production. Great economic and political importance is attached to the safety and availability of the nuclear power plants. For safety reasons neither the plant owners nor the Authority were willing to dispense with having a qualified engineer in permanent attendance at the plant, particularly during incidents, accidents or emergencies. For this reason the concept of picket engineer was introduced in 1972, through the initiative of the plant owners and with the approval of the Authority.

61269 (NUREG/CP—0031-Vol.1, pp 117-135) **Functions, role and organization of control room personnel including selection, training and qualifications in the Netherlands.** Lobbezoo, C.J. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

As with other complex, technical systems, the safety of a nuclear installation not only depends on the quality of the hardware but also on that of the organization, including the quality of the operators. The importance of skills and behavior of the operators and, more specifically, the man-machine interaction has been more and more recognized. Information is presented concerning shift organization; on-the-job training and licensing; retraining; simulator training; involving operators in plant occurrences; control room layout; and senior reactor operator.

61270 (NUREG/CP—0031-Vol.1, pp 137-155) **Nuclear power plant operator - a safety barrier - regulatory requirements in the FRG.** Fechner, J.B. (Federal Ministry of the Interior, Bonn, Germany). Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The great extent to which the operating personnel can influence the safety of nuclear power plant operation has been demonstrated by the incidents at the Brunsbuettel and at the TMI 2 nuclear power plants in 1978 and 1979. The results of the German Risk Study show that the large contribution (about 72%) of a small break LOCA to the overall probability of a core melt accident is mainly caused by human error events. Information is presented concerning personnel regulations and guidelines; requisite competence of shift personnel; qualifications of personnel; examination of shift supervisors and control room operators; retraining; reliability; and schedule of shift work.

61271 (NUREG/CP—0031-Vol.1, pp 195-205) **US NRC Division of Human Factors Safety perspective on operator training and qualifications.** Persensky, J.J. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The purpose of this paper is to describe some of the present and planned work which is designed to provide a technical basis for guidelines and regulations on training and qualifications of licensed operators and other nuclear power operations personnel.

61272 (NUREG/CP—0031-Vol.1, pp 257-272) **Role of INPO in improving training in the US nuclear power industry.** Mangin, A.M. Jun 1982. NTIS, PC A12/MF A01 - $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

In response to their newly recognized degree of interdependence, the US nuclear utilities formed the Institute of Nuclear Power Operations (INPO) in late 1979 to enhance nuclear plant safety and reliability nationwide. Because this interdependence extends across national boundaries, in 1981 INPO began accepting participants from outside the United States. To promote excellence in nuclear power plant training, INPO's Training and Education Division has established three objectives: to establish standards of excellence for industry training; to evaluate the quality and effectiveness of industry training programs; and to assist member utilities in providing high quality performance-based training. A variety of activities and projects have been undertaken to accomplish these objectives.

61273 (NUREG/CP—0031-Vol.1, pp 273-277) **Academic training for nuclear power plant operators.** Jones, D.W. (Memphis State Univ., TN). Jun 1982. NTIS, PC A12/MF A01 - $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

In view of the increasing emphasis being placed upon academic training of nuclear power plant operators, it is important that institutions of higher education develop and implement programs which will meet the educational needs of operational personnel in the nuclear industry. Two primary objectives must be satisfied by these programs if they are to be effective in meeting the needs of the industry. One objective is for academic quality. The other primary objective is for programs to address the specialized needs of the nuclear plant operator and to be relevant to the operator's job. The Center for Nuclear Studies at Memphis State University, therefore, has developed a total program for these objectives, which delivers the programs, and/or appropriate parts thereto, at ten nuclear plant sites and with other plants in the planning stage. The Center for Nuclear Studies program leads to a Bachelor of Professional Studies degree in nuclear industrial operations, which is offered through the university college of Memphis State University.

61274 (NUREG/CP—0031-Vol.1, pp 279-298) **Program to improve educational qualifications of reactor site technical personnel.** Christenson, J.M.; Eckart, L.E. (Univ. of Cincinnati, OH). Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

Following the TMI accident a widespread consensus in the United States developed about the need to improve the training and educational levels of the on-site staff concerned with the day-to-day operation and maintenance of a nuclear power reactor. Implementation of this idea has taken various forms, including the issuance of NRC regulatory requirements and INPO recommendations. This paper describes the planning and execution of a program that meets all of the Institute for Nuclear Power Operations (INPO) recommendations and NRC requirements for Shift Technical Advisor (STA) education. The program was developed for technical staff of the Zimmer Nuclear Power Station by the University of Cincinnati under contract to the Cincinnati Gas and Electric Co. (CG & E), the primary owner of the Zimmer Station. Initially the program was conceived for the specific purpose of meeting impending regulatory requirement for STA's. However, as the program has evolved, it is now seen as also having the broader purpose of producing a highly qualified site engineering staff with a common technical background.

61275 (NUREG/CP—0031-Vol.1, pp 315-329) **Training and requalification of operation personnel for RWE nuclear power plants.** Distler, K.; Kallmeyer, D.H. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

In the Federal Republic of Germany the development of commercial nuclear power plants and the development of training and qualification standards for operation personnel have experienced a parallel evolution. The commissioning of the first German experimental commercial nuclear power station, VAK, KAHL (15 MW) took place in 1961. Plant technology was produced in the USA and so was the major part of the personnel training. In 1966 the utilities established the first guideline dealing with the qualification and training of operation personnel. Eight years later - in 1974 - authorities and the utilities jointly formulated and the authorities issued the basic guideline. Since 1974 seven years have passed, seven nuclear power plants have been commissioned and four more guidelines have been issued. Training and retraining programs for reactor personnel are described.

61276 (NUREG/CP—0031-Vol.1, pp 331-347) **Accountability in power industry training.** Evans, R.C. (Arkansas Power & Light Co., Little Rock). Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

Accountability in power industry training translates to the moving away from purely subjective mode in development and evaluation to a more performance-based objective orientation. The performance-based approach increases the visibility of training through the specification and publication of training goals, procedures, and outcomes. The major thrust of accountability is in actually being able to see and therefore judge how well training dollars are being spent. This change in focus which addresses the functional concerns of the industry, what training is needed, its cost, how well it works, has brought about important innovations to industry training. The innovations have taken the form of a systematic design of training which employs concepts and approaches from educational psychology, industrial psychology, and human engineering.

61277 (NUREG/CP—0031-Vol.1, pp 349-354) **Command role - stress decision program.** Worsham, H.J. Jr.; French, J.L. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

With so many technical training programs required it is all too easy to forget the subjective, non-technical, training needs of the plant operating staff. These needs encompass what the various committees and task forces studying the Three Mile Island (TMI) incident identified as the command role. The command role includes the proper making of decisions, communications under stress, proper location of the shift supervisor and his people, and how to maintain a proper level of operational readiness. This paper describes a program designed to meet these plus operations/management team building needs. This program was originally developed in three phases and presented in conjunction with the TMI-1 operations staff as part of their post-incident requalification program.

61278 (NUREG/CP—0031-Vol.2) **CSNI specialist meeting on operator training and qualifications.** (Institute of Nuclear Power Operations, Atlanta, GA (USA); Nuclear Regulatory Commission, Washington, DC (USA); Nuclear Energy Agency, 75 - Paris (France). Committee on the Safety of Nuclear Installations). Jun 1982. 361p. (CONF-8110148—Vol.2; CSNI—63-Vol.2). NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

Portions of document are illegible.

The events during the accident at TMI-2, along with others identified in retrospect at other nuclear plants, re-emphasized the critical role of the reactor operator. Many countries are focusing greater attention on the capabilities of control room operating staff and on the problems they face. In view of the importance to safety on the subject, the CSNI Subcommittee on Licensing decided that a specialist meeting should be held on the broad aspects of operator selection and training and the functions and organization of operating staff. The meeting focused on the functions, role and organization of control room personnel as a crew and as individuals; selection and qualifications of personnel; operator training and requalification; evaluation of crew and individual performance; professional and career alternatives for control room personnel; and concepts for the future (e.g., implementation and impact of computer technology, advanced simulator concepts, off-site monitoring and support). Fourteen countries and three international organizations were represented. This report consists of two volumes. Separate abstracts are included for each of the papers presented except for one paper previously included in the data base.

61279 (NUREG/CP—0031-Vol.2, pp 5-22) **Implementation of a basic principle simulator.** De Greef, J.F. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

During the last twenty years, the Belgian Nuclear Energy Centre (SCK-CEN) gained a lot of experience in mathematical modelling and simulation of nuclear reactor power plant operation. The framework, in which these activities took place, was mainly concerned with security analysis of these devices and with training operation personnel of these plants. In the last years a fourth generation hybrid computer including an AD/FIVE analog computer of Applied Dynamics Inc. (ADI) and a PDP-11/34 digital computer of Digital Equipment Corporation (DEC) were installed. Furthermore, a home made operator's desk simulating the elements of the control room of a nuclear power plant completes the computer system for real-time training purposes. The described equipment is typically that of a Basic Principle Simulator, a device that quickly and effectively imparts the basic concepts of a nuclear power plant operation.

61280 (NUREG/CP—0031-Vol.2, pp 45-64) **Training simulators - major issues remain.** Grant, G.M. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The issues surrounding nuclear power plant simulators continue to be the focus of considerable industry attention and energy. Fundamental training issues include the use of performance objectives in simulator training and the importance of plant-specific simulators in achieving these objectives. To address these issues, examples of simulator performance objectives considered appropriate for operator training are developed. These are predicated on a defined operator role. The use of performance objectives in determining requirements for simulator hardware, software, and use is also exam-

ined. Finally, recommendations for further treatment of these subjects are made.

61281 (NUREG/CP—0031-Vol.2, pp 97-115) **Method for operator competence development in nuclear power plants.** Wirstad, J.; Anderson, H. (Ergonomrad AB, Karlstad, Sweden). Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The paper presents a method for operator competence development. Competence is defined as the ability of the operator to meet adequately all situations and states of the plant including normal operation, disturbances, transients and accidents. A set of closely related requirements and actions aiming for the acquisition and maintenance of operator competence is called the competency system. A description is given of the procedures to develop a competency system. The development of the competency system for Swedish nuclear power plants was organized in work groups with participation from the Nuclear Power Inspectorate, the utilities and Ergonomrad AB.

61282 (NUREG/CP—0031-Vol.2, pp 117-136) **Plant operator selection system for evaluating employment candidates' potential for success in electric power plant operations positions.** Dunnette, M.D. (Univ. of Minnesota, Minneapolis). Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The Plant Operator Selection System is a battery of tests and questionnaires that can be administered to job candidates in less than three hours. Various components of the battery measure what a job candidate has accomplished in previous educational and work situations, how well a candidate compares with others on a number of important aptitudes or abilities, and whether or not a candidate possesses the kind of personal stability required in power plant operations positions. A job candidate's answers to the tests and questionnaires of the Plant Operator Selection System are scored and converted to an OVERALL POTENTIAL INDEX. Values of the OVERALL POTENTIAL INDEX [OPI] range between 0 and 15. Candidates with high OPI values are much more likely to become effective and successful plant operators than candidates with low OPI values. It is possible to estimate the financial advantages to a company of using the Plant Operator Selection System in evaluating candidates for plant operations jobs.

61283 (NUREG/CP—0031-Vol.2, pp 137-140) **Human Factors Society study group progress report.** Sugarman, R.C. (Calspan Corp., Buffalo, NY); Mackie, R.R. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The Human Factors Society is conducting a study for the Nuclear Regulatory Commission to develop a comprehensive human factors plan for the next 10 years. This plan will meet the diverse requirements for human factors consideration imposed by the different regulatory functions and responsibilities of the various NRC program offices. Four technical areas are being examined in both the activities of the NRC and the nuclear power utilities and vendors. The areas are: human engineering; training and training devices; manpower and personnel; and procedures and operator aids.

61284 (NUREG/CP—0031-Vol.2, pp 141-151) **Associate degree in nuclear engineering: what does it offer to the training of reactor operators.** Baratta, A.J.; Penkala, J.L.; Witzig, W.F. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

This paper examines the case for degreed personnel in the control rooms. Specifically, the authors consider that as a minimum, reactor operators should possess an Associate Degree in Nuclear Engineering Technology from an accredited program. It is not the purpose of this paper to consider the educational needs of shift supervisors and other personnel. For the purpose of this paper, such a program will be defined as one meeting the American Nuclear Society - Accreditation Board for Engineering and Technology (ANS-ABET) criteria.

61285 (NUREG/CP—0031-Vol.2, pp 155-165) **Human factors research using the EPRI performance measurement system.** Kozinsky, E.J. (General Physics Corp., Chattanooga, TN). Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

A computer-based evaluation system has been developed for objectively measuring certain elements of an operator's performance on a power plant simulator. The Performance Measurement System (PMS) is designed to help the instructor in his total evaluation by providing measurements and documentation of certain essential elements of a trainee's performance. Some measurements of operator performance can be applied to Human Factors research on the operator - control room interface. The computerized system provides measurements of how the operator has responded to plant indicators and made switch manipulations. Magnetic tape data containing indications of all the control room gauges, annunciator lights, and switch and knob positions are collected, with time to one-second accuracy.

61286 (NUREG/CP—0031-Vol.2, pp 171-179) **Report on the pilot test to demonstrate the capabilities of the Comprehensive Occupational Data Analysis Program (CODAP).** Hale, J.R. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

CODAP is an acronym for the Comprehensive Occupational Data Analysis Program. It is a computer assisted occupational analysis system developed by the US Air Force Human Resources Laboratory which stresses the quantification and empirical testing of human performance factors for a given job or group of jobs. The Institute of Nuclear Power Operations (INPO) is conducting a pilot test of CODAP with Alabama Power Company to demonstrate the capabilities and usability of CODAP. The pilot test is being conducted on the mechanical maintenance job positions.

61287 (NUREG/CP—0031-Vol.2, pp 181-212) **Analytical techniques for creating a job design basis for a nuclear power plant operating crew.** Shea, D.J. Jr. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

Since the accident at TMI, the nuclear industry and its regulators have been in constant dialogue over the question of the qualification and training of nuclear plant personnel. From the early TMI Action Plan (NUREG-0660) to the most recent Commissioner's Proposal, SECY 81-84, that dialogue has lead to a wholesale increase in the qualifications required of the nation's Reactor Operators, Senior Reactor Operators, and Shift Supervisors. Two and a half years later that dialogue is at the point of suggesting that Reactor Operators be degreed with no indication that a degree requirement is the light at the end of the tunnel. While not implying that the dialogue has been without merit, this paper will nevertheless present a fundamentally different agenda for the post-TMI, lessons learned dialogue in the hope of starting a discussion that, unlike its predecessor, has an end-point in sight.

61288 (NUREG/CP—0031-Vol.2, pp 215-233) **Evaluating human reliability in the execution of routine NPP tasks: designing procedures to improve it.** Carnino, A.; Stephens, M. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

CSNI formed the Group of Experts in November 1978, giving it the tasks of assembling information on task structure and typical errors in routine tasks and of laying the groundwork for international exchanges of human error data. A guide has been completed that gives practical advice (that is not in any way a regulatory specification) to those persons, typically engineers, who actually write the test, maintenance and calibration procedures used in nuclear power plants. The Guide is divided into several sections: preparing to write or revise a procedure; drafting the step sequence; completing the master version; checking a new or revised procedure; preparing user copies; and encouraging error-free use of procedures. The paper briefly discusses the rationale behind many of the items in the Guide, and the problems that arose in agreeing

on several of them because of differences between countries in the philosophy of information presentation and in the normal behavior expected of the personnel that use such procedures.

61289 (NUREG/CP—0031-Vol.2, pp 253-270) **Patterns of shift work in the power industry: the need for circadian chronohygiene in bioengineering at the man-machine interface.** Ehret, C.F.; Cahill, A.L. (Argonne National Lab., IL). Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The most serious single omission in extant studies of human error rate prediction is in the failure to identify the contribution made by the stresses and stressors associated with shift-work. Furthermore, where shift work studies have been made, they have been chiefly in the form of descriptive characterizations of problems arising from the various ROTAS rather than in the form of interventions designed specifically to ameliorate such problems. In this paper, through an interplay of experiments involving animal models as simulators and human subjects we want first to characterize in biochemical and physiological terms the connections of circadian rhythms to the problems of the shift worker, and next to show some of the fairly simple steps that can be taken to ameliorate such problems.

61290 (NUREG/CP—0031-Vol.2, pp 271-285) **Implementation of an automated status analysis system in an operating nuclear power plant.** Christenson, J. (Halden Reactor Project, Norway); Graae, T.; Roggenbauer, H. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

In Sweden, and most other countries, the Technical Specifications are stipulated by the regulatory authorities and establish the framework (or envelope) within which the plant can be legally (and safely) operated. The specifications consist of a set of regulations which fall into four categories: administrative reporting requirements; acceptable limits of process parameters; routine periodic testing requirements; and conditions and restrictions on reactor operations related to the functional status of various safety systems. Accurate and reliable execution of the regulations in the last category is made difficult by the combined complexity of the safety system (which may consist of as many as 5000 functional elements) and the regulations (typically 50 or more typewritten pages). This paper describes an experimental system designed to both increase the reliability with which regulations in this category are executed and to also make this task easier for the operator to carry out. The system has been implemented on the Forsmark 1 Reactor and its efficacy is now under evaluation.

61291 (NUREG/CP—0031-Vol.2, pp 287-308) **Future: man's role in the nuclear power plant.** Courvoisier, P. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The author takes a look at the meaning of some frequently used terms, such as: training, qualification, who is man, and what is his role in a nuclear power plant. Views are presented on these terms and explanations are proposed for a number of further terms. The author sees that qualification is used in two ways and proposes that the term selection be used exclusively to refer to the process of finding (good) candidates for training and education, and the term licensing to their final admission to work in the envisaged post.

61292 **Neutron spectra at commercial nuclear plants.** Brackenbush, L.W.; Endres, G.W.R.; Faust, L.G. (PNL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **39:** 811-812(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 61363, 61367, 61368, 61435, 61497, 61499, 61500, 61504, 61507, 61523, 61524, 61527, 61536, 61537, 61541, 61542, 61544, 61549, 61550, 61551, 61552, 61553, 61554, 61571, 61576

61293 **(BARC—1067) Monte Carlo validation of supercell model for BWR fuel-assembly calculations.** Gupta, H.C.; Jagannathan, V. (Bhabha Atomic Research Centre, Bombay (India). Theoretical Reactor Physics Section). 1980. 34p. Dep. NTIS (US Sales Only), MF A01. Order Number DE82903348.

Portions of document are illegible.

The Monte Carlo method is used to validate a calculational model named as supercell model developed for the evaluation of LWR fuel box parameters. The TAPS reload-2 fuel box is chosen as a benchmark problem for the validation. The box parameters obtained using the supercell model and Monte Carlo method are compared.

61294 **(BNL-NUREG—31620) Statistical relation between single- and multiple-component failures.** Teichmann, T.; Papazoglou, I.A. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 5p. (CONF-821103—13). NTIS, PC A02/MF A01.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

This paper describes the results of some investigations of the statistical (and to some degree the qualitative) relation between single and multiple component failure events at US operating nuclear plants. The objectives of the investigations were to establish whether: multiple component failures could be attributed to random coincidences of single independent failures; there was any clear cut qualitative connection between the two type of failures; and there were any quantitative statistical parameters that related the two types of failure.

61295 **(EPRI-NP—1881) Categorization of cable flammability: intermediate-scale fire tests of cable tray installations. Interim report.** Sumitra, P.S. (Factory Mutual Research Corp., Norwood, MA (USA)). Aug 1982. 150p. NTIS, PC A07/MF A01. Order Number DE82906469.

In order to quantify the combustion behavior and determine the water extinguishment requirements for fires in an intermediate-scale cable tray installation and to obtain input for the proper design of future fusible link sprinkler fire tests, seven freeburn and ten extinguishment fire tests were conducted on three makes of cables. The tests involved two different sprinkler delivered densities, four types of cable loading (arrangement within the tray), and two types of tray arrangement (horizontal and mixed arrays).

61296 **(EPRI-NP—2560) Valve-stem-packing improvement study. Final report.** Adey, C.W.; Klein, J.J. (Stone and Webster Engineering Corp., Boston, MA (USA)). Aug 1982. 136p. NTIS, PC A07/MF A01. Order Number DE82906464.

By employing questionnaires and face-to-face interviews with valve and valve packing manufacturers, as well as nuclear plant personnel, an understanding of valve stem packing leakage problems from each of the three viewpoints was developed. This information, in-house experience, and available technical literature were used to develop specific recommendations for valve manufacturers, valve packing manufacturers, and nuclear plant valve users. It was generally recommended that each these groups make better use of graphite packing. The questionnaires and interviews indicated that increased usage of graphite packing over the last few years has reduced the incidence of valve packing problems. To confirm this, a survey of Licensee Event Reports (LERs) from 1972 to 1980 was undertaken using the keywords Valve and Packing. A statistical analysis of the LER data confirms that the adoption of graphite packing has significantly reduced valve stem leakage.

61297 **(HEDL-TC—1787) Decay heat and gamma dose-rate prediction capability in spent LWR fuel.** Neely, G.J.; Schmittroth, F. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1982. Contract AC06-76FF02170. 21p. NTIS, PC A02/MF A01. Order Number DE82021027.

The ORIGEN2 code was established as a valid means to predict decay heat from LWR spent fuel assemblies for decay times up to 10,000 year. Calculational uncertainties ranged from 8.6% to a maximum of 16% at 2.5 years and 300 years cooling time, respectively. The calculational uncertainties at 2.5 years cooling time are supported by experiment. Major sources of uncertainty at the 2.5 year cooling time were identifed as irradiation history (5.7%) and nuclear data together with calculational methods (6.3%). The QAD shielding code was established as a valid means to predict interior and exterior gamma dose rates of spent LWR fuel assemblies. A calculational/measurement comparison was done on two assemblies with different irradiation histories and supports a 35% calculational uncertainty at the 1.8 and 3.0 year decay times studied. Uncertainties at longer times are expected to increase, but not significantly, due to an increased contribution from the actinides whose inventories are assigned a higher uncertainty. The uncertainty in decay heat rises to a maximum of 16% due to actinide uncertainties. A previous study was made of the neutron emission rate from a typical Turkey Point Unit 3, Region 4 spent fuel assembly at 5 years decay time. A conservative estimate of the neutron dose rate at the assembly surface was less than 0.5 rem/hr.

61298 (INIS-mf—6714, pp vp) **Method for determining equivalent homogenized parameters.** Cheng, A.Y.; Hoxie, C.L.; Henry, A.F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A method for specifying homogenized parameters that will reproduce exactly all average reaction rates and leakage rates for large nodes into which a reactor may be partitioned is reviewed. Approximate methods for finding these ideal parameters are described and applications to PWR benchmark problems (for which the parameters are found non-iteratively) and to BWR benchmarks (for which an iteration is performed) are presented.

61299 (INIS-mf—6714, pp vp) **Model calibration methods for the BWR hybrid power shape monitoring system.** Frogner, B.; Ipaktchi, A. (Systems Control, Inc., Palo Alto, CA (USA)); Long, A.B. (Electric Power Research Inst., Palo Alto, CA (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

As part of the Hybrid Power Shape Monitoring System, a FLARE-type neutronics model coupled with a thermal-hydraulics model of a BWR have been implemented on a PRIME-750 computer and evaluated for two years at the Oyster Creek Nuclear Plant. The system monitors the state of the core (primarily the margins to MCPR, MLHGR, MAPLHGR and PCIOMR) in real time, detects anomalous conditions, and may be used to predict future load maneuvers. This paper describes model calibration methods used by the system for estimating the core power distribution by using information from both a physical model and in-core detector measurements. A few selected parameters can be adjusted to minimize the difference between the measured and predicted in-core detector readings. Remaining differences are then characterized by detector location, control rod position, and axial height. Errors due to model deficiency may be fed back to improve predictions. In-core and gamma scan data have been used to validate the methods. The results demonstrate better accuracy and grater anomaly detection sensitivity than conventional BWR core power monitoring systems.

61300 (INIS-mf—6845, pp vp) **DPsub(N) and QPsub(N) surface flux integral transport method in 1-dimensional geometries and in x-y geometry.** Stepanek, J. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The presented general surface flux integral transport method for calculating the space dependent multigroup neutron fluxes in reactor cells, cores or shielding is developed for one dimensional slab, sphere and cylindrical geometries and for x-y geometry. The spatial distribution of neutron flux and sources is represented by the spherical harmonics expansion while the double Psub(N) (DPsub(N), 1 dim.) or the quadruple Psub(N) spherical harmonics (QPsub(N), x-y) orthogonal in angular halfspaces or quadrants resp., are used to approximate the incoming and outgoing surface fluxes at the interfaces between the space intervals. The multigroup transport code SURCU was developed on the basis of this theory. It includes one dimensional slab, spherical and cylindrical geometry and two dimensional x-y geometry. The eigenvalue or volumic source problems can be calculated considering the 'white' or 'reflective' boundary conditions with general values of the albedos. The capability of this code is shown in comparison with the well known transport codes ANISN, DOT3, P1, MARSYAS, TRITON, DIT etc.

61301 (INIS-mf—6845, pp vp) **Application of the method of streaming rays to particle transport in complex geometries.** Filippone, W.L. (Lowell Univ., MA (USA)); Woolf, S. (Arcon Corp., Waltham, MA (USA)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A formulation is developed for the extension of the method of streaming rays to time-dependent, particle transport calculations in three-dimensional rectangular geometry. Although previous calculations with this method have been restricted to the two-dimensional, time-independent case, the preliminary results have shown sufficient promise, in comparisons with Ssub(N) calculations, to justify the extension. The streaming ray (SR) equations are first developed with the diamond difference approximation as the spatial differencing scheme. Results of time-independent, two-dimensional SR calculations are also presented along with comparisons with Ssub(N) and Monte Carlo for four geometrical configurations involving duct bends. The results shown here and previous preliminary calculations indicate that the SR method is more accurate than Ssub(N) for problems involving complicated geometries, deep penetration, collimated beam sources and streaming in a vacuum. Im most other situations the accuracies of the two methods were found to be approximately equal.

61302 **(LA-UR—82-2341) Calculations of thermal-reactor spent-fuel nuclide inventories and comparisons with measurements.** Wilson, W.B.; LaBauve, R.J.; England, T.R. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 28p. (CONF-820566—7). NTIS, PC A03/MF A01. Order Number DE82021772.

From Thermal reactor benchmark calculations, techniques, results and applications seminar; Upton, NY, USA (17 May 1982).

Comparisons with integral measurements have demonstrated the accuracy of CINDER codes and libraries in calculating aggregate fission-product properties, including neutron absorption, decay power, and decay spectra. CINDER calculations have, alternatively, been used to supplement measured integral data describing fission-product decay power and decay spectra. Because of the incorporation of the extensive actinide library and the use of ENDF/B-V data, it is desirable to compare the inventory of individual nuclides obtained from tandem EPRI-CELL/CINDER-2 calculations with those determined in documented benchmark inventory measurements of spent reactor fuel. The development of the popular ^{148}Nd burnup measurement procedure is outlined, and areas of uncertainty in it and lack of clarity in its interpretation are indicated. Six inventory samples of varying quality and completeness are examined. The power histories used in the calculations have been listed for other users.

61303 (NUREG—0020-Vol.6-No.4) **Licensed operating reactors. Status summary report, data as of 3-31-82.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Apr 1982. 420p. NTIS - GPO.

The US Nuclear Regulatory Commission's monthly Licensed Operating Reactors Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Management and Program Analysis, from the Headquarters Staff of NRC's Office of Inspection and Enforcement, from NRC's Regional Offices, and from utilities. Since all of the data concerning operation of the units is provided by the utility operators less than two weeks after the end of the month, necessary corrections to published information are shown on the Errata page. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

61304 (NUREG/CP—0031-Vol.1, pp 103-116) **Philosophy, practices and experience in operator training and licensing in Finland.** Friberg, M.; Laaksonen, J.; Reiman, L. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

At the moment there are four nuclear power plant units in operation in Finland, two PWR-type units in Loviisa and two BWR-type units in Olkiluoto. Information is presented concerning the power companies and regulatory authority; training of operating personnel; licensing of operators; and experience of operator licensing.

61305 (NUREG/CP—0031-Vol.1, pp 157-193) **Experience gained in Spain in licensing reactor operators.** Alonso, A.; Gutierrez, R.; Villajos, P.; Bilbao, F.; Ugedo, E.; Vargas, R. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The analysis of the Spanish experience in the training and performance of reactor operators has to be viewed against the characteristics of her nuclear power program and the position of the country within the context of the nations. The nuclear power program in Spain is described.

61306 (NUREG/CP—0031-Vol.1, pp 299-313) **Operator training and requalification at GPU Nuclear.** Long, R.L.; Barrett, R.J.; Newton, S.L. (GPU Nuclear, Parsippany, NJ). Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The operator training and requalification programs at GPU Nuclear's Oyster Creek (650 MWe BWR) and Three Mile Island-1 (776 MWe PWR) nuclear plants have undergone significant revisions since the Three Mile Island-2 accident. This paper describes the Training & Education organization, the expanded training facilities, including basic principle trainers and replica simulators, and the present operator training and requalification programs.

61307 (NUREG/CP—0031-Vol.2, pp 23-32) **Application of compact simulators in training programs.** Blomberg, P.E. (Studsvik Energiteknik AB, Nykoeping, Sweden); Heyer, D.W.; Sjoestrand, K. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The need for extensive simulation of nuclear power plants became apparent to the Swedish utilities when their first units were to be ordered in the late sixties. The first simulator model, STUDS, developed by STUDSVIK and the Swedish State Power Board in cooperation, dates from that period. Many modifications and complements have been introduced during the passed years and the STUDS simulators now in use model BWR and PWR systems quite extensively.

61308 (NUREG/CR—2719) **Evaluation of inservice inspections of greased prestressing tendons.** Dougan, J.R. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 74p. (ORNL/TM—8278). NTIS, PC A04/MF A01 - GPO.

Prestressed concrete containments in the United States using greased prestressing tendons are inspected periodically to ensure structural integrity and to identify and correct problem areas before they become critical. In the study, an analysis of the available utility surveillance data and an evaluation of the current and proposed guidelines were conducted. Comments from utility and industry personnel were factored into the analysis. The results indicated that the majority of the few incidences of problems or abnormalities that occurred were minor in nature and did not threaten the structural integrity of the containment. All of the available surveillance reports concluded that the respective containments were in good condition. However, the surveillance reports did reveal discrepancies between utilities in the interpretation of the results. Evaluation of the proposed guidelines also revealed areas that could be modified to provide improved results.

61309 (NUREG/CR—2757) **Zircaloy-cladding-embrittlement criteria: comparison of in-pile and out-of-pile results.** Haggag, F.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1982. Contract AC07-76ID01570. 59p. (EGG—2123). NTIS, PC A04/MF A01 - GPO.

Portions of document are illegible.

Zircaloy-4 cladding embrittlement data from both in-pile and out-of-pile experiments are compared and correlated with embrittlement criteria based on the fraction of the remaining beta phase, the extent of oxidation (equivalent cladding reacted), and the oxygen concentration in the beta phase. The in-pile data are from the Power-Cooling-Mismatch and Irradiation Effects Test Series performed in the Power Burst Facility reactor at the Idaho National Engineering Laboratory. The out-of-pile data are from isothermal oxidation experiments conducted at Argonne National Laboratory on simulated fuel rods in high-temperature steam. The zircaloy embrittlement criteria most applicable to severe fuel damage conditions are identified.

61310 **Issues concerned with future light-water-reactor designs.** Tong, L.S. (Nuclear Regulatory Commissions, Washington, DC). *Nuclear Safety;* **23**: No. 2, 127-145(Mar 1982).

This article discusses some light-water-reactor (LWR) design issues that are based on operating experiences and the results of water-reactor safety research. The impacts of these issues on reactor safety are described, and new engineering concepts are identified to encourage further improvement in future light-water-reactor designs.

61311 **Aerosol filtration.** First, M.W. (Harvard Univ., Boston, MA); Gilbert, H. *Nuclear Safety;* **23**: No. 2, 167-182(Mar 1982).

Significant developments in high-efficiency filtration for nuclear applications are reviewed for the period 1968 to 1980. Topics of special interest include (1) factory (bench) and in-place test methods, (2) new developments in paper and filter unit construction methods, (3) vented containment air cleaning systems for liquid-metal fast breeder reactors and light-water-moderated reactors, and (4) decontamination of off-gases from nuclear waste volume-reduction processes. Standards development has been vigorously pursued during this period, but advances in filtration theory have been few. One of the significant changes likely to occur in the immediate future is adoption of the European style of high-efficiency particulate air filters instead of those which have been in service for the past three decades to obtain the benefits of having almost twice as much filter paper in the same filter cartridge.

61312 **Testing of large-diameter pipe in a simulated BWR environment to evaluate stress corrosion cracking resistance.** Anderson, W.E.; Gilman, J.D.; Olson, N.J. (PNL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **39**: 453-455(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 61265, 61294, 61295, 61296, 61297, 61298, 61302, 61303, 61304, 61305, 61306, 61307, 61308, 61309, 61310, 61311, 61341, 61363, 61367, 61374, 61435, 61473, 61478, 61484, 61499, 61500, 61501, 61502, 61505, 61506, 61510, 61511, 61518, 61519, 61520, 61521, 61522, 61528, 61532, 61533, 61536, 61537, 61539, 61540, 61542, 61544, 61545, 61549, 61550, 61551, 61552, 61553, 61554, 61563, 61570, 61571, 61573, 61577, 61584

61313 **(BNL-NUREG—31390) Waste properties of a strippable coating used for the TMI-2 reactor building decontamination.** Dougherty, D.R.; Adams, J.W.; Barletta, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 4p. (CONF-821107—2). NTIS, PC A02/MF A01.

From Materials Research Society meeting; Boston, MA, USA (1 Nov 1982).

Strippable coating material considered for use in the TMI-2 reactor building decontamination has been tested for Sr, Cs, and Co leachability, for radiation stability, and for resistance to biodegradation. It was also immersion tested in water, a water solution saturated with toluene and xylene, toluene, xylene, and liquid scintillation counting (LSC) cocktail. Leach testing, performed using a modified IAEA procedure, resulted in all of the Cs and Co activity and most of the Sr activity being released from the coating in just a few days. Immersion resulted in swelling of the coating in all of the liquids tested. Gamma irradiation of the coating did not produce any apparent physical changes in the coating to a dose of 1×10^8 rad, however, radiolytic gas generation of H_2, CO, and CO_2 was observed. Biodegradation testing was performed in soil samples from the Barnwell, South Carolina, and Hanford, Washington, low-level waste disposal sites. These test results indicate that strippable coating radwaste of itself will not meet the requirements for stabilized Class B waste outlined in 10 CFR 61 (proposed) and the NRC Draft Branch Technical Position on Waste Form.

61314 **(BNL-NUREG—31619) Auxiliary feedwater-system reliability studies.** Youngblood, R.W.; Papazoglou, I.A. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 3p. (CONF-821103—19). NTIS, PC A02/MF A01.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

The purpose of this paper is to describe the BNL review process applied to the reliability analyses of Auxiliary Feedwater Systems (AFWS) submitted by operating license applicants to NRC in order to satisfy the pertinent Standard Review Plan requirements. Some generic comments on the availability characteristics of the AFWS are also presented. This work represents an application of a quantitative reliability goal to the regulatory process.

61315 **(DLCS—5000282) [Shippingport Atomic Power Station]. Quarterly operating report, second quarter 1982.** (Duquesne Light Co., Shippingport, PA (USA)). 1982. Contract AC11-76PN00292. 25p. NTIS, PC A02/MF A01. Order Number DE82021002.

At the beginning of the second quarter of 1982, the Shippingport Atomic Power Station was operating for Duquesne Light Company system grid at maximum base load with the 1A, 1B, 1C, and 1D reactor coolant loops and the 1AC and 1BD purification loops in service. The 1A, 1B, and 1C 991 psig self-actuated steam relief valves remained gagged during the quarter to prevent leakage through the valve seats. The 1D steam relief valve was removed during the Spring 1980 Shutdown for repairs and a blind flange was installed in its place. Gagging and/or removing of redundant relief valves is permitted by ASME Code and approved operating procedures. The station operated at maximum allowable power throughout the quarter, except as noted. The LWBR Core has generated 27,319.20 EFPH from start-up through the end of the quarter. There were no radioactive liquid discharges from the Radioactive Waste Processing System to the river this quarter. During the second quarter of 1982, a total of 550 cubic feet of radioactive solid waste was shipped out of state for burial. The shipments contained 0.007463 curies of radioactivity.

61316 **(EPRI-NP—2505) Effect of moisture-separator-drain routing on OTSG secondary-system chemistry.** Sawochka, S.G.; Sailor, W.C.; Pearl, W.L. (NWT Corp., San Jose, CA (USA)). Jul 1982. 56p. NTIS, PC A04/MF A01. Order Number DE82906470.

Impurity concentration data (corrosion, products, ionic, silica, and volatile species) for the secondary systems of four pressurized water reactor (PWR) power plants with once-through steam generators (OTSG) were obtained employing integrated sampling techniques and by a review of plant operating data. Based on these data, mass transport relations were developed to determine the effect of moisture separator drain (MSD) routing on final feedwater chemistry, and, hence, impurity transport to the OTSG.

61317 **(EPRI-NP—2541) PWR steam-side chemistry follow program. Final report.** Economy, G.; Wootten, M.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Aug 1982. 30[illegible]p. NTIS, PC A14/MF A01. Order Number DE82906483.

Denting is the diametral reduction of Inconel 600 tubes at the support plates of several nuclear steam generators during operation. This tube deformation was shown to be caused by the expansion forces resulting from formation of voluminous oxide generated by corrosion of the carbon steel support plate. The denting phenomenon and potential methods for its inhibition were investigated in the laboratory using isothermal capsules and heated crevice (heat transfer) testing at temperatures relevant to operating steam generators. Both test methods simulate the tube-support plate geometry and materials. Mathematical models were developed to predict the denting behavior of isothermal capsules. Three additives were investigated as potential denting inhibitors. Soaking with calcium hydroxide or sodium phosphate under heat transfer conditions did not inhibit denting when the environment was recontaminated, in contrast to similar soaks in boric acid which inhibited denting for two to four weeks following recontamination. When the boric acid soak was followed by on-line boric acid treatment, inhibition was maintained.

61318 **(EPRI-NP—2543) Remote detection of degradation of fire-resistant fluid lubricants.** Shestak, E.J. (Westinghouse Electric Corp., East Pittsburgh, PA (USA). Steam Turbine Generator Technical Operations Div.). Aug 1982. 78p. NTIS, PC A05/MF A01. Order Number DE82906461.

The original work under EPRI contract RP893-1 identified a phosphate ester lubricant as having the necessary lubricating and fire properties for use as a fire resistant lubricant in reactor coolant pump motors. However, these lubricants are subject to self-catalyzing degradation. The purpose of this added effort was to identify, review, and rank existing and innovative methods for remotely monitoring the lubricant degradation. Several possible techniques were identified and preliminary experimental evaluation was performed on three of them. Of the techniques considered, measurement of fluid resistivity or conductivity shows the most promise. The major advantages of conductivity measurement are that it is based on simple, mature hardware, thus providing high reliability of the instrumentation itself, and that there is substantial evidence that it will not give a false satisfactory indication as the fluid starts to degrade. The major disadvantages are that it is not a direct measure of fluid acid number, the pertinent degradation parameter, and that it is also affected by fluid contaminants, such as water, which may accelerate fluid degradation but are not directly related to the immediate condition of the fluid.

61319 **(GEND—024) Zeolite Vitrification Demonstration Program nonradioactive-process operations summary.** Bryan, G.H.; Knox, C.A.; Goles, R.G.; Ethridge, L.J.; Siemens, D.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1982. Contract AC07-76ID01570. 44p. NTIS, PC A03/MF A01. Order Number DE82021310.

The Submerged Demineralizer System is a process developed to decontaminate high-activity level water at Three Mile Island by sorbing the activity (primarily Cs and Sr) onto beds of

zeolite. Pacific Northwest Laboratory's Zeolite Vitrification Demonstration Program has the responsibility of demonstrating the full-scale vitrification of this zeolite material. The first phase of this program has been to develop a glass formulation and demonstrate the vitrification process with the use of nonradioactive materials. During this phase, four full-scale nonradioactive demonstration runs were completed. The same zeolite mixture being used in the SDS system was loaded with nonradioactive isotopes of Cs and Sr, dried, blended with glass-forming chemicals and fed to a canister in an in-can melter furnace. During each run, the gaseous effluents were sampled. After each run, glass samples were removed and analyzed.

61320 **(GEND—025) Zeolite Vitrification Demonstration Program: characterization of nonradioactive demonstration product.** Daniel, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1982. Contract AC07-76ID01570. 43p. NTIS, PC A03/MF A01. Order Number DE82022513.

An extensive characterization of specimens of the glass produced during Run 4 (ZVDP-4) of the nonradioactive phase of the Three Mile Island (TMI) Zeolite Vitrification Demonstration Program was conducted by the Materials characterization Center (MCC) at Pacific Northwest Laboratory (PNL). The characteristics of the ZVDP-4 glass were compared with those of MCC's borosilicate reference glass, MCC 76-68. Tests included analyses of composition, density and phases present, the MCC-1P Static Leach Test Method, measurements of tensile strength and impact behavior, and evaluation of high-temperature vaporization.

61321 (INIS-mf—6714, pp vp) **Nonlinear extension of the nodal expansion method.** Wagner, M.R.; Koebke, K.; Winter, H.J. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

During the last decade considerable progress has been made in developing improved coarse mesh methods for solving the three-dimensional neutron diffusion equation. A particular class of modern nodal methods has generally shown the ability to provide extremely accurate values for the eigenvalue, nodal powers and fluxes for a very coarse spatial mesh. However, this is only true if the reactor can be described in terms of nodewise constant cross sections or equivalent diffusion parameters. Unfortunately, in depleted light water reactor cores this assumption is not fulfilled. It is shown in this paper that for realistic PWR depletion and fuel management problems the error caused by neglecting the large burnup gradients may lead to an unacceptable loss of accuracy unless suitable corrections are introduced that account explicitly for the burnup-induced heterogenetics and their effect on the global solution. In order to overcome this basic difficulty a nonlinear nodal method has been developed as an extension of the nodal expansion method (NEM). Using second order approximations for the local flux shape as well as for representing the spatial variation of the cross sections, effective nodal parameters are computed during the iterative solution of the nodal equations. The spatial dependence of the cross sections is also taken into account when solving the one-dimensional diffusion equations for the transverse integrated flux. The results of series of two-dimensional nodal depletion calculations demonstrate that the depletion and feedback corrected nodal expansion method allows to eliminate, with practically sufficient accuracy, the discretional errors with respect to the smoothly varying cross sections with only a small increase in running time.

61322 (INIS-mf—6714, pp vp) **Advances in homogenization and dehomogenization.** Koebke, K. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The equivalence theory is a method to solve the homogenization and condensation problem in reactor physics. The theory is an alternative to commonly used homogenization methods and to diffusion theory. The objective of this paper is to demonstrate the practical application of the equivalence theory to LWR design problems. Assuming the neutronic interaction of assemblies, independent from the spatial direction, the resulting 'simplified equivalence theory' can be treated within the framework of conventional reactor design. The progress achieved by this homogenization, condensation and dehomogenization method is demonstrated by an idealized 4 group PWR-benchmark problem. Starting from spectral calculations for each assembly type and the reflector, a two group eqivalent coarse mesh solution determines the eigenvalue and the heterogeneous pinwise power distribution of the reactor problem with sufficient accuracy. Another application of equivalence theory is the development of an improved convergence acceleration technique. A numerical example is given.

61323 (INIS-mf—6714, pp vp) **Fuel management optimization for a PWR.** Dumas, M.; Robeau, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

This study is aimed to optimize the refueling pattern of a PWR. Two methods are developped, they are based on a linearized form of the optimization problem. The first method determines a feasible solution in two steps; in the first on the original problem is replaced by relaxed one which is solved by the Method of Approximation Programming. The second step is based on the Branch and Bound method to find the feasible solution closest to the solution obtained in the first step. The second method starts from a given refueling pattern and tries to improve this pattern by the calculation of the effects of 2 by 2, 3 by 3 and 4 by 4 permutations on the objective function. Numerical results are given for a typical PWR refueling using the two methods.

61324 (INIS-mf—6845, pp vp) **Thermal hydraulic computations of the secondary flow of a steam generator.** Coeffe, Y.; Graillat, G. (Electricite de France, 78 - Chatou. Lab. National d'Hydraulique:. 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Multidimensional two-phase flow codes have been developed in order to compute the secondary flow of a P.W.R. generator. Those codes are used to analyze the flow of existing steam generators particularly at the bottom of the tube bundle where corrosion problems arise. They are also being used for the design of a new version of PWR steam generator in order to test the modifications. The codes are based upon average equations of the multiphase fluid-solid medium. The liquid vapor flow is taken as homogeneous and momentum and heat transfers between the solid and the liquid phases are modelled. Only the bidimensional code BIGEVE is presently used extensively, especially to compute the flow at the bottom of the steam generators of BUGEY 4 and TRICATSTIN 1 power plants where measurements have been made.

61325 (NUREG/CP—0031-Vol.1, pp 23-51) **Training of PRW operators in Electricite de France.** Mira, J.J.; Martin, J.J. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

Electricite de France is today operating 29 nuclear units, including 5 natural uranium gas cooled reactors, with powers between 200 and 540 MWe, 1 heavy water reactor of 70 MWe, 1 PWR unit of 300 MWe, 1 breeder reactor of 230 MWe and 21 PWR units of 900 MWe. Eight PWR units of 900 MWe were started up in 1981, and five or six more will be commissioned in the course of each of the next few years. Such a programme will require an unprecedented effort of recruitment and training by the company. The problems raised by recruiting and training operating personnel for PWR power station are discussed.

61326 (NUREG/CP—0031-Vol.2, pp 33-43) **Improvements in simulator training for PWR.** Lindauer, E.; Simon, M.; Reppmann, D. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The paper mainly deals with a study, which was carried out on possible improvements in simulator training in the FRG. The aim of these investigations was to check the accidents and malfunctions already available at the simulator by means of systematic evaluation of operational experience and accident analyses and to suggest improvements resulting from this investigation. The investigations carried out so far which utilized the available operational experience for Pressurized Water Reactors (PWR) and accident analyses mainly considers the following aspects: increase of the spectrum of simulated accidents and malfunctions; enlargement of the simulation volume for particular accidents and malfunctions; and improvement of simulation accuracy. The paper describes the approach of the study, the results gained so far and future goals. Besides, a short survey on the situation in the training simulator field in the FRG is given.

61327 **(NUREG/CR—2834) Independent seismic evaluation of the Diablo Canyon Unit 1 containment annulus structure and selected piping systems.** Philippacopoulos, A.J.; Reich, M.; Bezler, P.; Miller, C.; Wang, Y.K.; Subudhi, M.; Shteyngart, S.; Brown, P. (Brookhaven National Lab., Upton, NY (USA)). Aug 1982. Contract AC02-76CH00016. 174p. (BNL-NUREG—51566). NTIS, PC A08/MF A01 - GPO $6.50.

Portions of document are illegible.

An independent review and development of the vertical floor spectra for the Unit 1 containment annulus structure of the Diablo Canyon Power Plant was carried out using a detailed three-dimensional model. The developed floor spectra were then utilized for confirmatory evaluations of two selected piping systems. The latter were evaluated by the envelope response spectrum method, and by the independent support motion response spectrum method. ASME class 2 evaluations of the two systems were also performed. Finally, a confirmatory evaluation was carried out for the model utilized by URS/Blume for the development of the vertical floor response spectra. Sections 1.1 and 1.2 of the report summarize the work scope and the results of the study. Details pertaining to the specific areas of the work are given in sections 2 to 8.

61328 **(SAND—82-1173) Examination results of the Three Mile Island radiation detector HP-R-213.** Mueller, G.M. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01. Order Number DE82022153.

Portions of document are illegible.

Area radiation detector HP-R-213 was removed from the Three Mile Island containment building on May 28, 1981. The detector apparently failed at the time of the hydrogen burn, and afterwards indicated radiation levels of less than 0.1mR/h. This report discusses the cause of failure, detector radiation measurement characteristics, and our estimates of the total gamma radiation dose received by the detector electronics.

61329 **Theoretical characterization of a dual-purpose gamma thermometer.** Burns, T.J.; Johnson, J.O. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **38**: 598-599(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61330 **Planned research program on the retired Surry-2A steam generator.** Clark R.A. (PNL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **39**: 827-828(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 61303, 61305, 61375, 61475, 61545

61331 **(DOE/ET/34202—67) Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development program. Progress report, October 1, 1981-December 31, 1981.** Kimball, O.F. (General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.). 15 Jun 1982. Contract AC02-76ET34202. 267p. NTIS, PC A12/MF A01. Order Number DE82019887.

Work covered in this report includes the activities associated with the status of the simulated reactor helium supply systems and testing equipment. The progress in the screening test program is descibed; this includes: screening creep results and metallographic analysis for materials thermally exposed or tested at 750°, 850°, 950° and 1050°C (1382°, 1562°, 1742°, and 1922°F) in controlled-purity helium. The status of creep-rupture in controlled-purity helium and air and fatigue testing in the controlled-purity helium in the intensive screening test program is discussed. The results of metallographic studies of screening alloys exposed in controlled-purity helium for 3000 hours at 750°C and 5500 hours at 950°C, 3000 hours at 1050°C and 6000 hours at 1050°C and for weldments exposed in controlled-purity helium for 6000 hours at 750°C and 6000 hours at 1050°C are presented and discussed.

61332 **(GEFR—00595) User's manual for ASTERIX-2: a two-dimensional modular-code system for the steady-state and xenon-transient analysis of a pebble-bed high-temperature reactor.** Lauer, A.; Schwiegk, H.J.; Wu, T.; Cowan, C.L. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Mar 1982. Contract AC03-80ET34034. 211p. (Juel—1750). NTIS, PC A10/MF A01. Order Number DE82021226.

Portions of document are illegible.

The ASTERIX modular code package was developed at KFA Laboratory-Juelich for the steady state and xenon transient analysis of a pebble bed high temperature reactor. The code package was implemented on the Stanford Linear Accelerator Center Computer in August, 1980, and a user's manual for the current version of the code, identified as ASTERIX-2, was prepared as a cooperative effort by KFA Laboratory and GE-ARSD. The material in the manual includes the requirements for accessing the program, a description of the major subroutines, a listing of the input options, and a listing of the input data for a sample problem. The material is provided in sufficient detail for the user to carry out a wide range of analyses from steady state operations to the xenon induced power transients in which the local xenon, temperature, buckling and control feedback effects have been incorporated in the problem solution.

61333 (NUREG/CP—0031-Vol.1, pp 53-75) **On and off-site training of technical staff in the UK nuclear power stations.** Myerscough, P.B. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The training requirements necessary to provide the staff for the operation of a utility's nuclear power station depend upon a number of factors including: the proportion of generating plant in the utility which is nuclear; the variety of the nuclear plant types, e.g., Magnox, AGR, PWR, BWR; and the statutory requirements imposed upon the utility for the safe operation of the nuclear plant. The nuclear training requirements of the CEGB are appropriate to a utility with approximately 56,000 MW total capacity with an installed nuclear capacity of 4800 MW of Magnox plant and 5200 MW of AGR plant operating or under construction. Thus the current training facilities are applicable to a gas-cooled technology with the possible introduction of PWR stations in the near future.

61334 **(SAAS—285) Effect of local burn-up variation on computed mean nuclide concentrations.** Moeller, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1982. 25p. (In German, Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702479.

Mean concentrations of U-235, U-236, U-238, Pu-239, Pu-240, Pu-241 and Pu-242 in some volume areas of WWER-440 fuel assemblies have been calculated from corresponding burn-up microdistribution data and compared with those calculated from burn-up mean values. Differences occurring were below 3% for the uranium nuclides but, at low burn-ups, considerable for Pu-241 and Pu-242.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 61508

61335 **(AECL—7165) Overview of heat exchanger technology in the Canadian nuclear program.** Carlucci, L.N.; Dalrymple, D.G.; Ko, P.L.; Pathania, R.; Pettigrew, M.I.; Scott, D.A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jun 1981. 16p. (CONF-810946—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702481.

From Conference on advancement in heat exchangers; Dubrovnik, Yugoslavia (7 Sep 1981).

This paper provides an overview of the Canadian approach to the reliability and serviceability of heat exchange equipment used in nuclear power stations and heavy water plants. Current work in vibration and fretting predictions, thermal-hydraulic analyses, and corrosion research is described. Procedures developed for in-service inspection, in situ tube replacment and chemical cleaning of corrosion products are also outlined.

61336 **(AECL—7254) Thermal-hydraulics in recirculating steam generators. THIRST code user's manual.** Carver, M.B.; Carlucci, L.N.; Inch, W.W.R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1981. 158p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE82702482.

This manual describes the THIRST code and its use in computing three-dimensional two-phase flow and heat transfer in a steam generator under steady state operation. The manual is intended primarily to facilitate the application of the code to the analysis of steam generators typical of CANDU nuclear stations. Application to other steam generator designs is also discussed. Details of the assumptions used to formulate the model and to implement the numerical solution are also included.

61337 **(CTA-EAV—019/80) Preliminary investigation of fuel cycle in fast reactors by the correlations method and sensitivity analyses of nuclear characteristics.** do Amorim, E.S.; de Castro Lobo, P.D. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Atividades Espaciais). Nov 1980. 44p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702673.

A reduction of computing effort was achieved as a result of the application of space - independent continuous slowing down theory in the spectrum averaged cross sections and further expressing then in a quadratic corelation whith the temperature and the composition. The decoupling between variables that express some of the important nuclear characteristics allowed to introduce a sensitivity analyses treatment for the full prediction of the behavior, over the fuel cycle, of the LMFBR considered. As a potential application of the method here in developed is to predict the nuclear characteristics of another reactor, face some reference reactor of the family considered. Excellent agreement with exact calculation is observed only when perturbations occur in nuclear data and/or fuel isotopic characteristics, but fair results are obtained whith variations in system components other than the fuel.

61338 **(FEI—1161) Mathematical model of fast reactor. Part 2. Thermohydraulics, strength.** Zinin, A.I.; Kolesov, V.E.; Voropaev, A.I.; Proshkin, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702661.

An approach to calculation of thermohydraulic and strength characteristics of a fast reactor core is considered. The algorithms for calculating temperature profile for a reactor operating in a stationary regime with cyclic overloadings are witten. Criteria for reliability evaluation of fuel elements and assembly shrouds are discussed. The problem of determination of optimal coolant flow rate distribution over throttling zones is formulated. The analysis of the above model of the core thermohydraulic and strength characteristics shows that this problem can be solved without using general methods of nonlinear programming. The algorithms considered are assumed as a basis for the package of applied programs for calculation and optimization of fast reactors.

61339 (INIS-mf—6714, pp vp) **Systematic method for correlating measurements of channel powers with the lattice constants in the neutron diffusion equations.** Buckler, A.N. (UKAEA Atomic Energy Establishment, Winfrith:. 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The paper describes methods for correlating a theoretical model of the spatial distribution of power generation (or related quantities) in a power reactor with measurements taken during operation. The aim is to adjust parameters in the model, which is subject to systematic error, in such a way as to provide a best fit to the measurements, which have a degree of random error. In this way a best estimate of power distribution at both measured and unmeasured locations may be obtained as an aid to the safe and economic operation of the reactor. A secondary aim is to improve the library of cross-section data. The method is based on Taylor's series expansions for the resulting changes in criticality condition and flux, when the lattice data is changed regionwise over the reactor. The problem in finally cast as a Least squares fitting procedure for the unknown cross-sections. Conventional perturbation theory may be derived as a natural consequence of the theory, but the method is superior in that it gives the first order perturbed flux, as well as any reactivity change. The method can be used with any thermal reactor system of current interest, but the first application was to provide a correlation code for studies with the Winfrith SGHW reactor, where the measurements of interest are channel powers. While the Paper concentrates on the mathematical techniques employed, a brief review of the results obtained for this reactor is presented.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 60960, 61019, 61020, 61426, 61431, 61485, 61498, 61512, 61513, 61514, 61515, 61532, 61538, 61545, 61560, 61561, 61564, 61566, 61574, 61575, 61579

61340 **(ANL-CT—82-11) Crossflow force transducer.** Mulcahy, T.M. (Argonne National Lab., IL (USA)). May 1982. Contract W-31-109-ENG-38. 56p. NTIS, PC A04/MF A01. Order Number DE82021141.

A force transducer for measuring lift and drag coefficients for a circular cylinder in turbulent water flow is presented. In addition to describing the actual design and construction of the strain-gauged force- ring based transducer, requirements for obtained valid fluid force test data are discussed, and pertinent flow test experience is related.

61341 **(ANL-CT—82-15) Scale modeling flow-induced vibrations of reactor components.** Mulcahy, T.M. (Argonne National Lab., IL (USA)). Jun 1982. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01. Order Number DE82021142.

Similitude relationships currently employed in the design of flow-induced vibration scale-model tests of nuclear reactor compo-

nents are reviewed. Emphasis is given to understanding the origins of the similitude parameters as a basis for discussion of the inevitable distortions which occur in design verification testing of entire reactor systems and in feature testing of individual component designs for the existence of detrimental flow-induced vibration mechanisms. Distortions of similitude parameters made in current test practice are enumerated and selected example tests are described. Also, limitations in the use of specific distortions in model designs are evaluated based on the current understanding of flow-induced vibration mechanisms and structural response.

61342 **(BNL-NUREG—31430) Analysis of the CRBRP part-load conditions using SSC/MINET.** Van Tuyle, G.J.; Guppy, J.G. (Brookhaven National Lab., Upton, NY (USA)). 18 May 1982. Contract AC02-76CH00016. 5p. (CONF-821103—8). NTIS, PC A02/MF A01.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

The Super System Code (SSC), coupled with the MINET (Momentum Integral Network) Code, was used to determine the plausibility of these postulated plant conditions, particularly with regard to whether the heat exchangers have sufficient heat transfer area for these conditions to prevail. The SSC/MINET representation of the Clinch River Plant used for the part load study is shown. SSC was used to analyze the reactor, the primary loop, and most of the intermediate loop. MINET was used for the rest of the CRBRP system. The analysis relies primarily on energy balances (SSC), an established package of heat transfer correlations (SSC and MINET), and two steady state momentum integral network solvers (MINET).

61343 **(EIR—437) CLUHET: a computer code for steady-state thermal-hydraulic calculations in heated rod bundles.** Barroyer, P. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1981. 129p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82906225.

Portions of document are illegible.

The basic equations used in CLUHET are presented, and their formulation for the solution by modern computer systems is described. A special attention is devoted to the physical meaning of the assumptions and solutions used as well as the accuracy of the computations. The code structure is extensively described and input and output are presented.

61344 **(EIR—439) Benchmark thermal-hydraulic analysis with the AGATHE HEX 37-rod bundle.** Barroyer, P.; Hudina, M.; Huggenberger, M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1981. 142p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82906236.

Different computer codes are compared, in prediction performance, based on the AGATHE HEX 37-rod bundle experimental results. The compilation of all available calculation results allows a critical assessment of the codes. For the time being, it is concluded which codes are best suited for gas cooled fuel element design purposes. Based on the positive aspects of these cooperative Benchmark exercises, an attempt is made to define a computer code verification procedure.

61345 **(GA-A—15603) Fuel cycles and advanced core designs for the gas cooled fast-breeder reactor.** Hamilton, C.J.; Perkins, R.G. (General Atomic Co., San Diego, CA (USA)). Jul 1982. Contract AT03-76SF71023. 106p. NTIS, PC A06/MF A01. Order Number DE82021663.

This report summarizes the fuel cycle and advanced core design analysis for the gas-cooled fast breeder reactor (GCFR) performed in conjunction with the Nonproliferation Alternative Systems Assessment Program (NASAP) and the International Nuclear Fuel Cycle Evaluation (INFCE) between 1976 and 1980. The report contrasts traditional fast reactor fuel cycles (plutonium/uranium) with alternative (uranium/thorium) cycles in an effort to define fuel systems which might reduce nuclear weapons proliferation risks without incurring extreme resource or economic disadvantages. It studies symbiotic reactor systems involving fast and thermal reactors and provides basic GCFR mass flow information for NASAP and INFCE. It defines an improved fuel cycle performance index (i.e., energy potential) for reactors and reactor systems. This improved index is combined with sensitivity studies of core materials and configurations to select the basic core and primary system characteristics for future core designs. This report establishes and characterizes advanced designs which may represent targets for future commercial-size fast reactors.

61346 **(HEDL-SA—2595) Load-deflection characteristics of small-bore insulated-pipe clamps.** Severud, L.K.; Clark, G.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1981. Contract AC06-76FF02170. 20p. (CONF-820601—10). NTIS, PC A02/MF A01. Order Number DE82016263.

From ASME pressure vessel and piping conference; Orlando, FL, USA (27 Jun 1982).

Portions of document are illegible.

The special insulated clamps used on both FFTF and CRBR piping utilize a Belleville spring arrangement to compensate for pipe thermal expansion. Analysis indicates that this produces a nonlinear, directionally sensitive clamp spring rate. Since these spring rates influence the seismic response of a supported piping system, it was deemed necessary to evaluate them further by test. This has been accomplished for the FFTF clamps. A more standard insulated pipe clamp, which does not incorporate Belleville springs to accommodate thermal expansion, was also tested. This type clamp is simple in design, and economically attractive. It may have wide application prospects for use in LMFBR small bore auxiliary piping operating at temperatures below 427°C. Load deflection tests were conducted on 2.54 CM and 7.62 CM diameter samples of these commercial clamps.

61347 (INIS-mf—6845, pp vp) **Plane modelling of unsteady non-isothermal incompressible flows.** Viollet, P.L.; Benque, J.P.; Bisch, A.M. (Electricite de France, 78 - Chatou. Lab. National d'Hydraulique:. 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

An algorithm using the velocity components and stream function has been developped for the computation of non isothermal incompressible flows. It is applied with finite difference numerical methods, using rectilinear or arbitrary non orthogonal curvilinear grids. This programm was developped in order to allow the analysis of thermal-fluid problems which occur in the study of reactor components (especially in LMFBR), as many of the encountered geometries are simple enough for allowing a plane description of the flow. The comparison with experiments appeared to be fairly good, and the resulting model is found to be a very useful tool for the understanding and prediction of the flow and temperature interaction.

61348 (INIS-SU—9, pp 163-171) **Radiative heat transfer in the Na mist dispersion over the hot surface of liquid Na in the cooling system of nuclear reactor.** Kunitomo, T.; Shafey, H.M. (Kyoto Univ. (Japan)). 1980. Dep. NTIS (US Sales Only).

From 4. all union conference on heat-masstransfer; Minsk, Byelorussian, USSR (Sep 1980).

The analysis has been carried out for the radiative heat transfer in the Na mist dispersion enclosed between the hot surface of liquid Na at temperature Tsub(n) and the cold surface of Na deposit at Tsub(c). The model selected for the present study represents the Na mist formed in a sodium cooled fast breeder reactor in which the condensed liquid particles are dispersed in the mixture of the Ar cover gas and the Na vapor. The analysis is based on replacing the inhomogeneous dispersing medium by three discrete homogeneous layers, and formulating the transfer equation for the monochromatic radiation in each layer according to the Chandrasekhar theory. The numerical calculations of the radiative qsub(r) and convective qsub(c) heat transfers have been performed for the wave length range lambda=1.6-30 μm and are compared. The qsub(r) has the same order of magnitude as the qsub(c) for all conditions of the mist dispersions. Both qsub(r) and qsub(c) increase by nearly equal rates with the increase of Tsub(H) and decrease by dif-

ferent rates with increasing Tsub(c). Variations of the particle diameter of the Na mist do not change substantially the qsub(r). Both qsub(r) and qsub(c) decrease slightly with the increase in the total thickness of the Na mist dispersion.

61349 **(ORNL/TM—8283) Summary of ENDF/B-V evaluations for carbon, calcium, iron, copper, and lead and ENDF/B-V Revision 2 for calcium and iron.** Fu, C.Y. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 57p. (ENDF—325). NTIS, PC A04/MF A01. Order Number DE82021115.

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This report, together with documents already published, describes the ENDF/B-V evaluations of the neutron and gamma-ray-production cross sections for carbon, calcium, iron, copper, and lead and the ENDF/B-V Revision 2 evaluations for calcium and iron.

61350 **(ORNL/TM—8362) DOS: the discrete-ordinates system.** Rhoades, W.A.; Emmett, M.B. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 91p. NTIS, PC A05/MF A01. Order Number DE82021091.

Portions of document are illegible.

The Discrete Ordinates System determines the flux of neutrons or photons due either to fixed sources specified by the user or to sources generated by particle interaction with the problem materials. It also determines numerous secondary results which depend upon flux. Criticality searches can be performed. Numerous input, output, and file manipulation facilities are provided. The DOS driver program reads the problem specification from an input file and calls various program modules into execution as specified by the input file.

61351 **Design of U.S. LMFBR developmental plant.** Longenecker, J. (DOE, Washington, DC 20545). *Transactions of the American Nuclear Society;* **38**: 612-613(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61352 **CRBRP: operability, inspectability, and maintainability.** Bradbury, P.; Kosky, R.E.; O'Bryant, W.J. (Westinghouse Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **38**: 614-615(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61353 **Two-dimensional computational modeling of sodium boiling in simulated LMFBR fuel pin bundles.** Dearing, J.F. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **38**: 755-757(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61354 **Two-phase simulation of a seven-pin bundle flow-rundown transient.** Domanus, H.M.; Schmitt, R.C.; Sha, W.T.; Shah, V.L. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **38**: 757-758(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61355 **Mixing studies of a 1/15 scale loop-type plenum.** Howard, P.A.; Oras, J.; Shiu, K.K. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **38**: 760-762(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61356 **Heat exchanger low flow thermal transient-induced buoyancy effects.** Bobis, J.P.; Kasza, K.E.; Lawrence, W.P. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **38**: 768-770(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61357 **A numerical procedure for calculating temperature profiles in LMFBR coolant channels.** Guppy, J.G.; Horak, W.C.; Kennett, R.J. (BNL, Upton, NY 11973). *Transactions of the American Nuclear Society;* **39**: 495-496(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61358 **Performance of commercially produced mixed-oxide fuels in EBR-II.** Hales, J.W.; Lawrence, L.A. (Westinghouse Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **35**: 207-209(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61359 **Structural analysis of a radial row of FFTF fuel assemblies.** Taylor, J.P.S.; Diven, J.N.; Highland, J.A.; McMullen, R.; Peistrup, P.E.; Sutherland, W.H. (Westinghouse Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **35**: 438-439(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61360 **Effective thermal conductivity for combined convection-radiation heat transfer in a molten oxide fuel layer.** Epstein, M.; Chawla, T.C.; Cheung, F.B.; Hauser, G.M. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **35**: 364-365(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61361 **Post-test examination results of SLSF experiment P3A.** Holland, J.W.; Kelman, L.R. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **35**: 370-371(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

61362 **(LA—9417-MS) Hypervelocity-impact studies on titanium, titanium alloys, and beryllium.** Lundberg, L.B.; Bless, S.J.; Girrens, S.P.; Green, J.E. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 67p. NTIS, PC A04/MF A01. Order Number DE82021174.

The hypervelocity-impact behavior of commercial-pure, Grade 2 Ti, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo-0.25Si, and pure beryllium was studied by impacting targets of these materials with millimeter-sized spheres of glass, copper, aluminum, and cadmium propelled from a light-gas gun at velocities ranging from 4.5 to 7.6 km/s. Target temperatures ranged from 295 to 775°K when impacted. Semi-infinite targets were impacted to determine cratering behavior, and some correlations were made to thin-target perforation. Thin titanium targets with a variety of surface coatings and finishes were also impacted. Titanium and the titanium alloys were found to behave in a ductile manner when impacted, but beryllium was found to be brittle even at 775°K. An extrapolation equation was used to optimize a titanium heat pipe radiator mass for a space nuclear power application.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 61523, 61527

61363 **(DOE/NE—0030/5-82) US central station nuclear electric generating units: significant milestones (status as of April 1, 1982).** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Converter Reactor Deployment). Sep 1982. 38p. NTIS, PC A03/MF A01. Order Number DE82021148.

Milestone dates are presented concerning the licensing and operating activities of US nuclear power plants. Listings of US nuclear power plants are also presented in alphabetical arrangement by state and alphabetical arrangement by electric utility. Projected US nuclear power plant growth is presented through the year 1990.

61364 **(NUREG—0090-Vol.5-No.1) Report to Congress on abnormal occurrences, January 1-March 31, 1982.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Aug 1982. 51p. GPO$4.75.

The report states that there were four abnormal occurrences at the nuclear power plants licensed to operate. The first involved diesel generator engine cooling system failures. The second involved pressure transients during shutdown. The third involved major deficiencies in management controls. The fourth involved a steam generator tube rupture. There were no abnormal occurrences for the other NRC licensees during the report period. The Agreement States reported no abnormal occurrences to the NRC. The report also contains information updating some previously reported abnormal occurrences.

61365 **(NUREG—0304-V3-SUP) Regulatory and technical reports, compilation for 1975-1978 (supplement).** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Apr 1982. 26p. NTIS, PC A03/MF A01.

This compilation lists formal staff and contractor reports issued by the U.S. Nuclear Regulatory Commission that were not listed in 'Regulatory and Technical Reports for 1975 - 1878', NUREG-0304, Vol. 3. This compilation contains a listing of reports and their abstracts and a keyword index.

61366 **(NUREG—0390-Vol.6-No.1) Topical report review status.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Aug 1982. 207p. NTIS - GPO.

A Topical Report Review Status is scheduled to be published semi-annually. The primary purpose of this document is to provide periodic progress reports of on-going topical report reviews, to identify those topical reports for which the Nuclear Regulatory Commission (NRC) staff review has been completed and, to the extent practicable, to provide NRC management with sufficient information regarding the conduct of the topical report program to permit taking whatever actions deemed necessary or appropriate. This document is also intended to be a source of information to NRC Licensing Project Managers and other NRC personnel regarding the status of topical reports which may be referenced in applications for which they have responsibility. This status report is published primarily for internal NRC use in managing the topical report program, but is also used by NRC to advise the industry of report review status.

61367 **(NUREG—0580-Vol.11-No.8) Regulatory licensing status summary report. Nuclear power plants data for decisions (blue book), July 11-August 16, 1982.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Aug 1982. 70p. GPO.

This management report, Regulatory Licensing status summary report, is designed to provide the necessary information for controlling the progress of review processes for central station nuclear reactor applications. Section I of this edition consists of the three summary of accomplishments, the new application forecast for OL's and CP's, and an abbreviation key. Section II represents the main body of the report and consists of the facility information. All OL's are listed first, followed by CP's, standard design reviews, other reviews, and finally, a non-power reactor summary. Each project consists of general facility data, current status for all phases of the review, and targeted and actual completion dates for all key milestones in the review.

61368 **(NUREG—0887-Suppl.1) Safety evaluation report: related to the operation of Perry Nuclear Power Plant, Units 1 and 2, Docket Nos. 50-440 and 50-441, Cleveland Electric Illuminating Company.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1982. 41p. GPO $4.75.

Supplement No. 1 to the Safety Evaluation Report on the application filed by the Cleveland Electric Illuminating Company on behalf of itself and as agent for the Duquesne Light Company, the Ohio Edison Company, the Pennsylvania Power Company, and the Toledo Edison Company (the Central Area Power Coordination Group, CAPCO), as applicants and owners, for a license to operate the Perry Nuclear Power Plant, Units 1 and 2 (Docket Nos. 50-440 and 441). The facility is located near Lake Erie in Lake County, Ohio. This supplement has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission and reports the status of certain items that had not been resolved at the time of publication of the Safety Evaluation Report.

61369 **(NUREG—0936-Vol.1-No.2) NRC regulatory agenda. Quarterly report, April-June 1982.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). Jul 1982. 191p. GPO $7.50.

The Nuclear Regulatory Commission is issuing the July edition of the Regulatory Agenda. The Regulatory Agenda is a compilation of all rules on which the NRC has proposed or is considering action and all petitions for rulemaking which have been received by the Commission and are pending disposition by the Commission. The agenda consists of two sections. Section I entitled Rules includes: (A) Rules on which final action has been taken since April 9, 1982, the cutoff date of the last Regulatory Agenda, (B) Rules published previously as proposed rules and on which the Commission has not taken final action, (C) Rules published as advance notices of proposed rulemaking and for which neither a proposed nor final rule has been issued; and (D) Unpublished rules on which the NRC expects to take action. Section II entitled Petitions for Rulemaking includes: (A) Petitions incorporated into final rules or petitions denied since April 9, 1982, (B) Petitions incorporated into proposed rules, (C) Petitions pending staff review, and (D) Petitions with deferred action.

61370 **(NUREG/CR—2833-Vol.1) Critical human-factors issues in nuclear-power regulation and a recommended comprehensive human-factors long-range plan. Executive summary.** Hopkins, C.O.; Snyder, H.L.; Price, H.E.; Hornick, R.J.; Mackie, R.R.; Smillie, R.J.; Sugarman, R.C. (Human Factors Society, Inc., Santa Monica, CA (USA)). Aug 1982. 62p. GPO $5.00.

This comprehensive long-range human factors plan for nuclear reactor regulation was developed by a Study Group of the Human Factors Society, Inc. This Study Group was selected by the Executive Council of the Society to provide a balanced, experienced human factors perspective to the applications of human factors scientific and engineering knowledge to nuclear power generation. The report is presented in three volumes. Volume 1 contains an Executive Summary of the 18-month effort and its conclusions. Volume 2 summarizes all known nuclear-related human factors activities, evaluates these activities wherever adequate information is available, and describes the recommended long-range (10-year) plan for human factors in regulation. Volume 3 elaborates upon each of the human factors issues and areas of recommended human factors involvement contained in the plan, and discusses the logic that led to the recommendations.

61371 **(NUREG/CR—2833-Vol.2) Critical human-factors issues in nuclear-power regulation and a recommended comprehensive human-factors long-range plan. Programs evaluation and recommended long-range plan.** Hopkins, C.O.; Snyder, H.L.; Price, H.E.; Hornick, R.J.; Mackie, R.R.; Smillie, R.J.; Sugarman, R.C. (Human Factors Society, Inc., Santa Monica, CA (USA)). Aug 1982. 382p. GPO $9.50.

This comprehensive long-range human factors plan for nuclear reactor regulation was developed by a Study Group of the Human Factors Society, Inc. This Study Group was selected by the Executive Council of the Society to provide a balanced, experi-

enced human factors perspective to the applications of human factors scientific and engineering knowledge to nuclear power generation. The report is presented in three volumes. Volume 1 contains an Executive Summary of the 18-month effort and its conclusions. Volume 2 summarizes all known nuclear-related human factors activities, evaluates these activities wherever adequate information is available, and describes the recommended long-range (10-year) plan for human factors in regulation. Volume 3 elaborates upon each of the human factors issues and areas of recommended human factors involvement contained in the plan, and discusses the logic that led to the recommendations.

61372 **(NUREG/CR—2833-Vol.3) Critical human-factors issues in nuclear-power regulation and a recommended comprehensive human-factors long-range plan. Critical discussion of human factors areas of concern.** Hopkins, C.O.; Snyder, H.L.; Price, H.E.; Hornick, R.J.; Mackie, R.R.; Smillie, R.J.; Sugarman, R.C. (Human Factors Society, Inc., Santa Monica, CA (USA)). Aug 1982. 277p. GPO $8.00.

This comprehensive long-range human factors plan for nuclear reactor regulation was developed by a Study Group of the Human Factors Society, Inc. This Study Group was selected by the Executive Council of the Society to provide a balanced, experienced human factors perspective to the applications of human factors scientific and engineering knowledge to nuclear power generation. The report is presented in three volumes. Volume 1 contains an Executive Summary of the 18-month effort and its conclusions. Volume 2 summarizes all known nuclear-related human factors activities, evaluates these activities wherever adequate information is available, and describes the recommended long-range (10-year) plan for human factors in regulation. Volume 3 elaborates upon each of the human factors issues and areas of recommended human factors involvement contained in the plan, and discusses the logic that led to the recommendations.

61373 **Portents of proposed changes to 10 CFR 20.** Kathren, R.L. (PNL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **38**: 591(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

2108 Economics

REFER ALSO TO CITATION(S) 61239, 61345, 61639

61374 **(DOE/ET/34022—5) Improved uranium utilization in PWRs. Final report.** Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Aug 1982. Contract AC02-79ET34022. 74p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82021054.

Portions of document are illegible.

This is the final summary progress report on a research program carried out within the MIT Energy Laboratory/Nuclear Engineering Department under the US Department of Energy's program to increase the effectiveness of uranium utilization in light water reactors on the once-through fuel cycle. Two major themes, methodology and applications, characterize the research. A simple but accurate set of algorithms, designated as the linear reactivity method were developed to permit self-consistent evaluations of a broad spectrum of changes in core design and fuel management tactics. More than a dozen suggested improvements were then evaluated, focusing primarily on retrofitable modifications and pressurized water reactors. In common with the findings of many other investigators, high burnup and routine end-of-cycle coastdown were identified as preferred options.

2109 Process Heat Reactors

61375 **(ORNL/TM—8226) Initial dynamic simulation of an HTGR sensible energy transport and storage plant.** Ball, S.J.; Clapp, N.E. Jr. (Oak Ridge National Lab., TN (USA)). Jun 1982. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01. Order Number DE82016578.

Dynamic models were developed for a General Atomic Company reference design of a high-temperature gas-cooled reactor sensible energy transport and storage (SETS) plant. The resulting computer code uses the IBM simulation language CSMP. The purpose of the program was to investigate the basic dynamic response behavior and controllability. The plant was found to have excellent inherent stability and control features.

22 NUCLEAR REACTOR TECHNOLOGY

61376 (INIS-mf—6714, pp vp) **Suitability of parallel computer architecture for nuclear engineering applications.** Hoermann, H.A. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Having in mind that the technology available today limits the switching speed of computers in the range of nanoseconds, dramatic advances in performances are only achievable by the architectural approach of prallelism. Such parallelism can be realized on different levels: (1) Sub-operation (Micro-instruction), (2) Basic operation, (3) Task (as part of a job), (4) Job. Another classification - based on the parallelism in data and instruction streams - classifies the various architectures in four different categories: (1) SISD (Single Instruction Single Data Stream), (2) SIMD (Single Instruction Multiple Data Stream), (3) MISD (Multiple Instruction Single Data Stream), (4) MIMD (Multiple Instruction Multiple Data Stream). With the exception of type (3) class, all these architectures have been realized in a variety of different approaches. Such systems - available or under development - are presented and discussed with respect to possible application in the field of nuclear engineering.

61377 (INIS-mf—6714, pp vp) **Review of ANS-19 standards and activities.** Weitzberg, A. (NUS Corp., Rockville, MD (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The standards subcommittee ANS-19, 'Physics of Reactor Design' sponsored by the ANS Reactor Physics Division, has been in existence since 1972. Five standards have been produced, two data review groups have been established, and a working group has reviewed reactor physics terms for inclusion in the N 1.1 American National Standard Glossary of Terms in Nuclear Science and Technology. Much to the disappointment of those of us involved in their development, these standards have for the most part been uniformly ignored by all segments of the nuclear industry. Nevertheless, there is still great interest in revising the standards to make them more useful. It is hoped that the changes now under consideration as well as possible new standards areas of physics inputs to safety and transient calculations and operational power reactor measurements for license compliance will help to bring this about. There is a general feeling that within the large and diverse nuclear industry there is real benefit to be gained both technically and in public perception by the introduction of increasing standardization of good engineering practices. Such standardization to have maximum benefit must come from the technical experts within the industry, rather than being imposed by the regulators.

61378 (INIS-mf—6714, pp vp) **Application of parallel computing systems to nuclear engineering problems.** Werner, W.F. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The utilization of the potential of parallel computing systems for nuclear engineering applications is explored. The discussion is based on the example of the simulation problem for a nuclear plant. It investigates the possibilities to parallelize the time integration of large system of differential equations which contributes significantly to the computing time of the simulation problem. It is shown that recently developed packages for the solution of systems of differen-

tial equation can be parallelized to a great extent. Development of parallel iterative methods for the solution of linear systems of equations is identified as area of needed future research.

61379 (INIS-mf—6845, pp vp) **Review of Green's function methods in computational fluid mechanics: Background, recent developments and future directions.** Dorning, J. (Illinois Univ., Urbana (USA). Nuclear Engineering Program). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The research and development over the past eight years on local Green's function methods for the high-accuracy, high-efficiency numerical solution of nuclear engineering problems is reviewed. The basic concepts and key ideas are presented by starting with an expository review of the original fully two-dimensional local Green's function methods developed for neutron diffusion and heat conduction, and continuing through the progressively more complicated and more efficient nodal Green's function methods for neutron diffusion, heat conduction and neutron transport to establish the background for the recent development of Green's function methods in computational fluid mechanics. Some of the impressive numerical results obtained via these classes of methods for nuclear engineering problems are briefly summarized. Finally, speculations are proffered on future directions in which the development of these types of methods in fluid mechanics and other areas might lead.

61380 **(NP—2903645) Annual report of the Swiss Federal Institute for reactor research for 1980.** (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). 1980. 194p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82903645.

Portions of document are illegible.

Information is given on the Institute's research and development activities including research topics on reactor systems, high-temperature reactors with helium turbines, fast breeders, safety and environmental protection, nuclear fusion technology, solar heat and energy production, nuclear waste, fuel development, chemical heat management, nuclear chemistry, and radioactive waste disposal. 418 references.

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61381 **(AECL—6809) WIMSTAR-4: a computer program for generating WIMS library data from ENDF/B.** Wilkin, G.B. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Aug 1981. 97p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE82702475.

WIMSTAR (Version 4) is a FORTRAN-IV computer program developed to generate data files for the WIMS lattice code library from the ENDF/B data base. The program must be used in conjunction with the AMPX-II system and has been designed for implementation as a module of that system. This report describes the structure, implementation and use of the AMPX/WIMSTAR system.

61382 **(CTA-EAV—011/80) Time constraints in the treatment of nuclear transients - MONSTREAV code.** do Amorim, E.S.; Sudano, J.P.; de Moura Neto, C.; Ferreira, W.J. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Atividades Espaciais). Aug 1980. 34p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702671.

An improved approach to the spatial dynamics problem is described. This approach alows the factorization of the flux in amplitude and shape functions. Boundaries conditions are treated as time dependent functions and the coupling between functions is treated as the improved quasistatic approximation (1,2). A burnup feedback has been included allowing to describe extreme excursion in fast reactors very accurately even for treatment of nonlinear problems. A benchmark analysis shows that an improved method is fully sufficient for fast reactor dynamics calculations. Computation modules embodying the improved model of neutronic behaviour will be integrared with the other tests of the fast reactor dynamics analysis system now under development at EAV-IAE.

61383 **(FEI—1192) Analysis of potentialities of different-type breeders in a multicomponent model of nuclear power.** Ilyunin, V.G.; Murogov, V.M.; Rudneva, V.Ya.; Shmelev, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702674.

The calculational analysis of indexes for different versions of the multicomponent nuclear power (NP) model using various types of breeders is conducted. Three main versions of the developing NP with reactors of different types are considered: a) without the NP system additional feeding from an external source, b) with the NP system additional feeding with fuel from a special breeder not supplying electric energy to the system, c) with the NP system additional feeding with nuclear fuel from a breeder which supplies electric energy to the system as well. The analysis of relations obtained shows that in the closed-in- fuel NP model under consideration there are practically no sufficient realistic conditions for use of the special secondary nuclear fuel breeders without producing parallel to the fuel also the energy for the system. One of the basic arguments which proves the necessity of alternative breeder development is the requirement of assuring the future NP applicable structure in which about 50-60% of energy should be generated by thermal reactors. Investigations show that fast BN-type reactors with impved fuel, for example, using metal fuel assure the possiro/bility of the NP closed-in-fuel model development with the given part of NPPs with thermal reactors.

61384 **(FEI—1219) Conditional variable separation and accounting for neutron leakage in p1-approximation.** Nevinitsa, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702662.

The method of calculation of a two-dimensional axial-symmetric cylindrical model of a reactor is proposed. It is shown that accounting the neutron flux density in P-1 approximation increases the accuracy of calculational prediction of critical parameters of hydrogen- containing systems. The described algorithm allows to exclude from calculation transport cross section and connected with its determination errors. Uptime expenditures necessary for calculating one version of a reactor reduce approximately 10 times. It is concluded that the proposed algorithm for calculation of neutron leakage can be used in one-dimensional computer codes by means of their insignificant reconstruction.

61385 **(FEI—1223) Program for reactor criticality calculation in (r,phi,z)-geometry (the RFZ program).** Zemskov, E.A.; Isakova, L.Ya.; Rachkova, D.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702663.

The RFZ program for the few-group diffusion three- dimensional calculation of criticality for nuclear reactor with arbitrarily arranged system of absorbing rods is presented. The cylindrical reactor consisting of different physical zones with a system of absorbing rods is under consideration. Cylindrical rods with different dimensions and properties are arbitrarily arranged over the reactor height and cross section. The rods may be located both: in cores and in a reflector. Physical properties of reactor geometric zones are fixed by appropriate sets of macroscopic constants. Physical properties absorbing rods and vacant channels for rods are determined by effective boundary conditions. The calculation is conducted in the group diffusion approximation. The parameters characterizing the program are the following number of energy groups less than 4, number of zones over radius less than 10, number of zones over height less than 10 number of rods in a symmetry element less than 30. The program is written in FORTRAN language for the BESM-6 computer.

61386 **(FEI—1227) Optimizational calculation of a heterogeneous burnable poison in a reactor core.** Isakova, L.Ya.; Vtorova, O.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702664.

A method for optimizational calculation of basic parameters of burnable poison rods is proposed. The method is based on determining the additions to the homogenized absorption cross section connected with the presence of burnable poisons simultaneously with calculation of such core parameters as the cell geometric characteristics, chemical compositions of fuel and burnable poisons, coefficients of absorption cross sections in zones, imitating the reactor control system. On the basis of analysis of testing calculational results the conclusion is drawn that the described method is available for solving optimizational problems connected with determination of the composition, and number of burnable poison rods in the zones of the nuclear reactor physical profiling as well as for solving the other, analogous problems, for example, when calculating the reactor cores with complex heterogeneous inserts.

61387 (INIS-mf—6714, pp vp) **Nodal imbedded calculation for the retrieval of local power peaking from coarse mesh reactor analysis.** Jonsson, A.; Grill, S.; Rec, J.R. (Combustion Engineering, Inc., Windsor, CT (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A nodal imbedded, fine mesh, mesh centered diffusion theory computational method and Fortran code module (MC) has been developed for use as an integral portion of LWR coarse mesh neutronics simulators. This enables such simulators to keep track of the evolution of local power peaking and depletion not normally available in coarse mesh. The MC module performs the imbedded, fine mesh computation in about 1/7 of the CPU time required by a comparable planar PDQ. The ROCS coarse mesh simulator combined with the MC module delivers 3D coarse mesh and multiplanar fine mesh information in a single job step thus eliminating the need for separate planar PDQ calculations in PWR design work. A method has been developed for determining diffusion coefficients which, when combined with the unique finite difference formulation of MC, permits the inclusion of transport effects in a rigorous fashion. Comparisons of ROCS/MC with PDQ predictions of local peaking show that assembly pin peaks differ by only 1.5% RMS. Performance is excellent throughout core interiors. Additional work is needed for assemblies located at the core periphery.

61388 (INIS-mf—6714, pp vp) **Analytic coarse-mesh approximations for solving diffusion equations in hexagonal and square geometries.** Arkuszewski, J.J.; Makai, M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The coarse-mesh two-dimensional analysis of reactor core is split into two problems: determination fo the response matrix elements from the diffusion equation for homogenized nodes and finding the overall neutron balance from the response matrix and balance equations. The local solution to the homogeneous node is assumed to be a linear combination of fundamental solutions to the diffusion equation. The above method is presented here in two distinct formulations: a general multigroup one for hexagonal and a two-group for square shaped nodes. In the former both flux and source density are represented by a linear combination of fundamental solutions what leads to a set of inhomogeneous response matrix equations, while in the latter the flux is expressed as a superposition of asymptotic and transient components with subsequent decomposition into irreducible representations of symmetry transformations group on the square. Both methods are implemented in prototype computer programs. Some illustrative results are given.

61389 (INIS-mf—6714, pp vp) **Heterogeneous-element coarse-mesh method for the numerical solution of the multigroup neutron diffusion equations.** Dieter, O.M.B.; Dorning, J.J. (Illinois Univ., Urbana (USA). Nuclear Engineering Program). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A heterogeneous-element coarse-mesh diffusion theory method has been developed for the efficient numerical solution of multidimensional neutron diffusion problems. The method, which is the heterogeneous-element analogue and logical extension of the previously developed partial current balance method, uses the same local Green's function technique to transform the multidimensional group diffusion-removal equations to coupled local integral equations for the neutron partial currents. This is followed by the conversion of these local integral equations to matrix equations by a weighted-residuals method. The matrix elements (coupling parameters) of this local Green's function method are determined approximately for heterogeneous-volume computational elements by means of a variational functional for these parameters. Two-dimensional diffusion theory problems have been solved to verify the feasibility of this new variational partial current balance method. These include a super-mesh calculation that includes four different homogeneous fuel assemblies in one coarse-mesh heterogeneous computational volume element, and three assembly-size coarse-mesh calculations for heterogeneous assemblies which include parts of control blades, water gaps and several fuel regions.

61390 (INIS-mf—6714, pp vp) **Use of blending functions of interpolation and approximation for diffusion problems.** Devooght, J.; Mund, E. (Brussels Univ. (Belgium)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The blending function method of Gordon and coworkers combines in an optimal way information drawn from the fluxes taken along lines instead of the usual way of taking fluxes at lines intersections. The blended interpolant is used as a trial function for a collocation method applied to a two dimensional diffusion problem. The solution is synthesized from a set of one dimensional problems along x, y, coupled through the solution of a low dimension linear algebraic system. Numerical results show convergence consistent with theoretical results and a substantial reduction of unknowns compared to a Ritz-Galerkin method.

61391 (INIS-mf—6714, pp vp) **Energy separation method for fusion-fission hybrid blanket neutronics analysis.** Cheng, E.T. (General Atomic Co., San Diego, CA (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

An energy separation method for fusion-fission hybrid neutronic analysis is developed. This method is based on the idea of decoupling the fusion and fission neutrons by separating the energy range at some energy level. Above this specified energy level, the fraction of fission neutrons contributing to the flux distribution is negligible and below this level the fraction of fusion source neutrons is also vanishing. For fusion-fission hybrid blanket burn-up calculations, this method may provide savings in both computer time and development effort.

61392 (INIS-mf—6714, pp vp) **Simulation of a parallel processor on a serial processor: The neutron diffusion equation.** Honeck, H.C. (Computer Application Technology, Inc., Aiken, SC (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Parallel processors could provide the nuclear industry with very high computing power at a very moderate cost. Will we be able to make effective use of this power. This paper explores the use of a very simple parallel processor for solving the neutron diffusion equation to predict power distributions in a nuclear reactor.

We first describe a simple parallel processor and estimate its theoretical performance based on the current hardware technology. Next, we show how the parallel processor could be used to solve the neutron diffusion equation. We then present the results of some simulations of a parallel processor run on a serial processor and measure some of the expected inefficiencies. Finally we extrapolate the results to estimate how actual design codes would perform. We find that the standard numerical methods for solving the neutron diffusion equation are still applicable when used on a parallel processor. However, some simple modifications to these methods will be necessary if we are to achieve the full power of these new computers.

61393 (INIS-mf—6714, pp vp) **Comparison of vector computer methods for the solution of slab geometry neutron transport problems.** Lewis, E.E. (Northwestern Univ., Evanston, IL (USA). Technological Inst.); Swanson, C.D. (Control Data Corp., Roseville, MN (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The use of a vector computer is examined for the solution of fixed-source neutron transport problems in slab geometry. The non-vectorizable nature of the recursive marching algorithms used in conventional discrete ordinates codes is discussed. The second-order even-parity form of the transport equation is then used to formulate discrete ordinates and Legendre polynomial approximations, using finite elements in space. The even-parity methods result in highly effective solution algorithms, since the iterative procedures utilize a vectorized routine for the solution of tridiagonal matrix equations. A series of codes is implemented on the Control Data Corporation CYBER 205 vector computer to examine the merits of the discrete ordinates and Legendre polynomial methods. For large problems both methods based on the even-parity equation are found to give markedly shorter times per iteration than the conventional discrete ordinates marching algorithm. The even-parity discrete ordinates algorithm is found to have the shortest time per iteration and to have convergence properties that are better understood than those of the Legendre polynomial method. A vectorized synthetic acceleration method is combined with the even-parity discrete ordinates method to yield rapid convergence in situations where unaccelerated iteration on the scattering source is ineffectual.

61394 (INIS-mf—6714, pp vp) **Efficient technique from the simulation of large systems.** Girijashankar, P.V.; Hetrick, D.L.; Keepin, W.N.; Palusinski, O.A. (Arizona Univ., Tucson (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The simulation of large engineering systems such as nuclear reactors involves the numerical integration of a large set of differential equations. Often this runs into difficulties using conventional integration techniques because of stiffness. This stiffness is sometimes caused by highly oscillatory solutions for a small subset of system variable, and we will refer to such systems as two-time-scale and oscillatory stiff. Significant savings in computer CPU time could be gained by partitioning the system into (a) those variables which produce highly oscillatory solutions necessitating a small step size and (b) the remaining variables which can be integrated by using a relatively large step size. Two examples drawn from two different engineering fields (1) an autopilot model and (2) a pressurized water reactor model will be used to illustrate the scheme of partitioning and subsequent integration of the two subsystems, yielding considerable savings in computer CPU time.

61395 (INIS-mf—6714, pp vp) **Real-time simulation of the transient behaviour of local and global PWR core and plant parameters.** Hoeld, A.; Lupas, O. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A 3D real-time non-linear model is presented, describing the transient situation of a PWR nuclear power plant as dependent on both external control actions or disturbances and the inherent core dynamics (i.e., feedback terms coming from the nodal moderator and fuel rod temperature values and the xenon-iodine distribution along the core). The plant has been assumed to consist of a 3D-core (subdivided into a number of superboxes), a natural-circulation U-tube steam generator and the main steam system (with safety, bypass and control valves and a steam turbine). The total plant can be disturbed from outside by a movement of control rods or rod banks, an injection or dilution of soluble boron acid and changes in the main coolant and feed water mass flow, feed water temperature and secondary outlet steam mass flow. Restrictions are imposed by the requirement that the resulting code (named GARLIC) could be also operated parallel (i.e., in real time) to the actual reactor process on a process computer (eventually in connection with a color display).

61396 (INIS-mf—6790, pp vp) **Measurement of coolant velocity by correlation method.** Smolik, J.; Majer, J.; Vlcek, J.; Katranic, S. (Skoda, Plzen (Czechoslovakia)). 1980. (In Czech). Dep. NTIS (US Sales Only).

From WWER diagnostic assemblies conference; Pizen, Czechoslovakia (23 Aug 1979).

Coolant flow velocity in fuel elements is measured using the cross correlation of natural temperature fluctuation of the non-isothermal coolant flow. A thermocouple is used as a sensor. The dynamic properties of the thermocouples, their selection and placement, the shaping and processing of the thermocouple signals are discussed.

61397 (INIS-mf—6845, pp vp) **Weighted residual methods for the solution of fluid dynamics problem.** Werner, W.F. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

During the past few years, Weighted Residual (WR) Methods have been introduced to the solution of fluid dynamic problems in nuclear engineering. Among the many possible WR-methods, separated region methods, using separate spaces for test- and weighting functions (ASWR) are particular attractive for the solution of hyperbolic problems. Due to the flexibility of this particular kind of WR-methods, phenomena typical for fluid dynamic problems, like discontinuities of derivatives can be treated accurately and efficiently. The paper describes the stages of development and the present status of a general purpose fluid dynamics code utilizing the ASWR-method. Accuracy and efficiency, relative to conventional methods, are demonstrated for typical applications.

61398 (INIS-mf—6845, pp vp) **Basic character of five two-phase flow model equation sets.** Wen Ho Lee (Los Alamos Scientific Lab., NM (USA)); Lyczkowski, R.W. (Illinois Inst. of Tech., Chicago (USA)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Three test problems were simulated using five different two-phase flow model equation sets from the open literature. The test problems chosen were a fluidized-bed, batch settling and horizontal jet impingement on a vertical wall. These three problems demonstrate an important cross-section of physical phenomena such as fluidized-bed voidage oscillations, phase separation, countercurrent flow and jet formation. The dispersed flow regime is selected for all three problems. The study was performed to assess the basic character of the five field equation sets responding to the same initial and boundary conditions and using the same finite difference numerical scheme. The general performance of the five equation sets was found to be similar even though one of them is ill-posed as an initial-value problem. Broad trends are the same and quantitative differences could be assessed by examining the fine structure of the results. None of the equation sets could be entirely rejected on the basis of producing physically impossible or unacceptable results.

61399 (INIS-mf—6845, pp vp) **TRITON computer code finite difference methods for one dimensional single or two-fluid flow transient computation.** Le Coq, G.; Libmann, M.; Raymond, P.; Souchet, Y.; Sursock, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

In this paper two new numerical methods for computing two phase flow transients are presented. One methods uses a semi-implicit technique and the other one applies a fully implicit technique. A computer module: TRITON, has been developped using these two methods. The physical modeling of this code is the two fluid flow model with six partial differential equations, the various transfer terms between wall and fluid or between liquid and steam are given by correlations implemented into the POSEIDON Nuclear Safety Analysis Computer code system.

61400 (INIS-mf—6845, pp vp) **α-stable variable order ODE-solver and its application as advancement procedure for simulations in thermo- and fluid-dynamics.** Hofer, E. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Simulations in thermo- and fluid dynamics often require the numerical solution of large initial value problems with stiffness caused by eigenvalues close to the imaginary axis. The regions of absolute stability of the most widely used ordinary differential equation (ODE) solvers, for stiff problems, do not properly account for this. The paper introduces a general purpose ODE-solver with considerably larger stability regions. Its reliability is illustrated by test problems, with complex eigenvalues, from a well known test package. Applications in large codes, for simulations in thermo- and fluid dynamics, demonstrate its practical usability.

61401 (INIS-mf—6845, pp vp) **Computation of 2D compressible flows with a finite element method.** Montagne, J.L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

When the homogeneous modeling of the two phase flow is used, the set of equations describing the flow is similar to an Euler system. Mixed finite elements are appropriate to discretize the equations. First, main properties of this kind of elements are reminded. Then, some properties of semi-implicite schemes on stability and entropy are given. Numerical tests have been performed, and the scheme gave satisfactory results.

61402 (INIS-mf—6845, pp vp) **Review of characteristic methods used to solve the linear transport equation.** Alcouffe, R.E.; Larsen, E.W. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

We review a selection of characteristic methods used to solve the linear transport equation. The methods of solution distinguish themselves in how the characteristics used for computation are selected and how the source term is approximated. We conclude by recommending criteria upon which a production method should be based.

61403 (INIS-mf—6845, pp vp) **Solution of the multigroup neutron transport equation using spherical harmonics.** Fletcher, K. (UKAEA Risley Nuclear Power Development Establishment:. 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A solution of the multi-group neutron transport equation in up to three space dimensions is presented. The flux is expanded in a series of unnormalised spherical harmonics. Using the various recurrence formulae a linked set of first order differential equations is obtained for the moments psisup(g)sub(lm)(r), γ(g)sub(lm)(r). Terms with odd l are eliminated resulting in a second order system which is solved by two methods. The first is a finite difference formulation using an iterative procedure, secondly, in XYZ and XY geometry a finite element solution is given. Results for a test problem using both methods are exhibited and compared.

61404 (INIS-mf—6845, pp vp) **Approximate analytical solution of two-dimensional multigroup P-3 equations.** Matausek, M.V.; Milosevic, M. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Iterative solution of multigroup spherical harmonics equations reduces, in the P-3 approximation and in two-dimensional geometry, to a problem of solving an inhomogeneous system of eight ordinary first order differential equations. With appropriate boundary conditions, these equations have to be solved for each energy group and in each iteration step. The general solution of the corresponding homogeneous system of equations is known in analytical form. The present paper shows how the right-hand side of the system can be approximated in order to derive a particular solution and thus an approximate analytical expression for the general solution of the inhomogeneous system. This combined analytical-numerical approach was shown to have certain advantages compared to the finite-difference method or the Lie-series expansion method, which have been used to solve similar problems.

61405 (INIS-mf—6845, pp vp) **Study of some numerical schemes for solving the three dimensional transport equation.** Courtot, M. (CEA Centre d'Etudes de Vaujours, 93 - Sevran (France)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Taking advantages of a three dimensional discrete ordinates transport code implementation, we have encoded and tested three different approximations for (x, y, z) spatial differencing. All of them involve 'edge' and 'mesh' values of the discrete ordinate angular flux: the first one assumes a linear mesh flux and continuous edge flux like in THREETRAN; the second one assumes an exponential mesh flux and continuous edge flux; the third one assumes a linear mesh flux but discontinuous edge flux. For our numerical experiments, we tried two typical problems. The first one is a source calculation for the Clinch River Breeder Reactor lower axial shield already performed by the TRANS 3 Code. The second one is a k-eigenvalue calculation of a fuel transport cask already performed by Monte Carlo Codes MORSE and KENO IV.

61406 (INIS-mf—6845, pp vp) **Linear characteristic method for spatially discretizing the discrete ordinates equations in (x,y)-geometry.** Larsen, E.W.; Alcouffe, R.E. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

In this article a new linear characteristic (LC) spatial differencing scheme for the discrete ordinates equations in (x,y)-geometry is described and numerical comparisons are given with the diamond difference (DD) method. The LC method is more stable with mesh size and is generally much more accurate than the DD method on both fine and coarse meshes, for eigenvalue and deep penetration problems. The LC method is based on computations involving the exact solution of a cell problem which has spatially linear boundary conditions and interior source. The LC method is

coupled to the diffusion synthetic acceleration (DSA) algorithm in that the linear variations of the source are determined in part by the results of the DSA calculation from the previous inner iteration. An inexpensive negative-flux fixup is used which has very little effect on the accuracy of the solution. The storage requirements for LC are essentially the same as that for DD, while the computational times for LC are generally less than twice the DD computational times for the same mesh. This increase in computational cost is offset if one computes LC solutions on somewhat coarser meshes than DD; the resulting LC solutions are still generally much more accurate than the DD solutions.

61407 (INIS-mf—6845, pp vp) **Nodal methods for discrete-ordinates transport problems in (x,y) geometry.** Walters, W.F.; O'Dell, R.D. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A nodal method has been developed for improved spatial differencing of the discrete-ordinates form of the x,y geometry transport equation. In applying this method, spatial flux expansions are assumed along the edges of each solution node (mesh cell) and flux and source expansions are assumed in the interior of the node. Nodal method schemes are thus identified by the expansions used for node edges and node interior. Nodal schemes assuming constant-constant, constant-linear, and four forms of linear-linear expansion have been developed, programmed, and used in the analysis of eigenvalue (ksub(eff)) and shielding problems. Nodal results are compared with those obtained using the diamond-difference scheme.

61408 (INIS-mf—6845, pp vp) **Status of integral transport theory.** Kavenoky, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The integral transport theory has been first applied to one-dimensional problems: these treatments are presented with their most recent developments involving polynomial expansions and anisotropic scattering. Nowadays the more important developments are aimed to two-dimensional problems: two different approaches are used, the first one uses 2D polynomial expansion and the second one is based on the surface source method. The last part is devoted to recent advances: treatment of doubly heterogeneous media (grain geometries), 2D solution using the characteristics method and finit attempts to 3D solution.

61409 (INIS-mf—6845, pp vp) **Unfinished Monte Carlo business.** Gelbard, E.M. (Argonne National Lab., IL (USA)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The present weaknesses of Monte Carlo methods rather than their capabilities are dealt with. First of all it should be noted that there are important transport calculations that we can't do very well by deterministic methods, and which can't be done by Monte Carlo either. Thus it seems we can't compute, without significant approximations: eigenvalue perturbations caused by perturbations in the scattering cross sections: or perturbations which, locally, are very large, while their net effects are very small. Weaknesses in Monte Carlo perturbations calculations will be reconsidered, briefly, later. Of coarse it is still true that no Monte Carlo code can calculate a flux or activation shape.

61410 (INIS-mf—6845, pp vp) **Homogenization procedure for lattices, homogenized diffusion coefficients, and the eigen-coefficient approach.** Deniz, V.C. (Bhabha Atomic Research Centre, Bombay (India)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

This paper deals with two different methods of treatment of eigen-value problems for multiplying and non-multiplying regular lattices. The first is the eigen-coefficient approach proposed by Deniz in 1967. The second is the homogenization approach leading to diffusion equations, for which diffusion coefficients have been defined by Benoist (1959, 1964), Bonalumi (1971), Williams (1971), Gelbard (1974), Larsen (1976) and Deniz (1978). A formulation applicable to any eigen-problem is employed, and it includes the eigen-problems for ksub(eff) and for decay constant. The treatment is in the variables of space, velocity, and angle.

61411 (INIS-mf—6845, pp vp) **Generalization of the Benoist formalism for anisotropic neutron transport computation.** Lewis, E.E. (Northwestern Univ., Evanston, IL (USA). Dept. of Mechanical Engineering; Northwestern Univ., Evanston, IL (USA). Dept. of Nuclear Engineering). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A method is presented for treating anisotropic streaming effects in multi-dimensional transport computations. The homogenized transport equation is first modified by incorporating an anisotropic multiplicative factor into the streaming term. The angular dependence of this factor is determined by requiring the Benoist small-buckling leakage approximation for slab lattices to be preserved in the anisotropic transport equation. An anisotropic diffusion equation with Benoist coefficients then results when the P_1 approximation is applied. The anisotropic transport equation, a discrete ordinates approximation to it, and the anisotropic diffusion equation are compared to exact Monte Carlo results for buckled lattices. The anisotropic transport discrete ordinates approximation is incorporated into a production transport code, and results for two-dimensional problems are compared to anisotropic diffusion theory.

61412 (INIS-mf—6845, pp vp) **Development of the SPH homogenization method.** Hebert, A.; Kavenoky, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Cell-by-cell homogenization, using standard flux weighting, leads to inaccurate reaction rates. Effective cross sections should be computed to obtain the same cell-averaged reaction rates in the detailed reference calculations and in the smeared one. A new homogenization method had been investigated: starting from a detailed heterogeneous calculation using fine group 2D transport theory, effective homogenized cross sections are determined to be used in a coarse calculation based on transport or diffusion theory with an eventually collapsed group grid. All the cell reaction rates and the assembly-averaged flux are preserved: the effective cross sections are calculated using the least squares method and the needed derivatives are computed by an explicit generalized perturbation method. Numerical results are presented for two benchmarks; the first one is a 9-cell assembly proposed by Halsall and the second is a typical 15x15 PWR assembly.

61413 (INIS-mf—6845, pp vp) **Solution of the integral transport equation across a plane boundary.** Milgram, M.S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Applied Mathematics Branch:. 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A new numerical technique (singular derivatives or SDsub(N)) is developed that is particularly efficient in obtaining the solution to the integral transport equation in the vicinity of a plane boundary. This allows the flux densities in contiguous plane regions

to be estimated, with exact matching of the flux and its angular components across the interface (up to the order of truncation N chosen). Thus the method is the converse of the diffusion equation. The technique consists of expanding the flux in functions which reproduce the analytic singularities of the solution at a plane boundary, and numerically solving the algebraic (matrix) equations which emerge. Numerical results are presented for a variety of two body problems involving adjoining media with continuous and discontinuous sources and material properties. Deficiencies of the method are discussed and possible remedies indicated. Early results suggest that further development is warranted, and the extension to a multimedia and multi-group formalism is outlined.

61414 (INIS-mf—6845, pp vp) **Fsub(N) method in radiative transfer and neutron transport theory.** Maiorino, J.R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The Fsub(n) method basic to radiative transfer and neutron transport theory is discussed. In order to illustrate the accuracy of the method, a numerical example of the albedo and transmission factor of the slab albedo problem in one speed anisotropic transport theory is given and compared with 'exact' results.

61415 (INIS-mf—6845, pp vp) **Three dimensional simulation of large power reactors.** Crowther, R.L.; Congdon, S.P.; Crawford, B.W.; Kang, C.M.; Leonard, A.; Martin, C.L.; McDaniel, C.T.; Schwager, L.A.; Wolters, R.A. (General Electric Co., San Jose, CA (USA). Nuclear Energy Div.). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

This paper is a summary of the current status of 3-D simulation of large power reactors with particular emphasis on the requirements for effective 3-D simulation methods and on the requirements for reliability testing, verification, and qualification. The general basis for current coarse mesh and fine mesh methods are briefly reviewed and new adaptive methods which are now being applied to BWR 3-D simulation are summarized. 3-D simulation of large power reactors has improved considerably over the past decade as a result of development of better, more fundamentally based methods and improved numerical techniques; improvements in multigroup spectrum averaging and homogenization methods for nuclear data input; a larger operating plant data base; completion of special detailed operating plant measurement of space and/or time dependent local 3-D fission rates, activations and fission product distributions; improvements in computer hardware and software; development of better fine mesh benchmarks; and introduction of more comprehension, detail, feedback and power plant coupling in the 3-D simulation models. In-spite of these improvements, most methods are not yet at a fully satisfactory level of development.

61416 (INIS-mf—6845, pp vp) **Experience, status and advanced applications of PRESTO.** Borresen, S. (Scandpower A/S, Kjeller (Norway)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Experience gained through application of PRESTO over the past ten years has led to significant improvements and extensions of the code. This paper describes some of the theoretical developments and provides some experimental comparisons for illustration of obtained accuracy. A revised formulation of the nodal coupling equation is derived for non-cubical nodes. It is shown that results using this new formulation do not differ significantly from those of the original method in actual reactor analysis. A method for theoretical calculation of core-reflector boundary conditions, based on fine-mesh diffusion theory results, is discussed. The existence of such procedures is essential for application of PRESTO in predictive - future cycle analyses. Code features of an analysis of the Hatch gamma scan data with PRESTO, using lattice data from RECORD, are described. The total nodal standard deviation was 6.8%, with a bundle power standard deviation of 2.9%. Advanced applications of PRESTO as an on-line simulator are discussed. Benchmarks results for various minicomputers are given.

61417 (INIS-mf—6845, pp vp) **Fast two- and three-dimensional one group coarse-mesh diffusion program in hexagonal geometry.** Lukas, H.; Wehmann, U. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The fast one group coarse-mesh diffusion program DEGEN was developed for the calculation of power distribution and absorber worth in two- and three-dimensional hexagonal geometry. The method of DEGEN is described. It has the option of a linear or quadratic flux approximation within the meshes and makes use of Askew's method for the mesh-size correction. The results of DEGEN are compared with those of a reference code based on the fine mesh finite difference method. The comparison shows the following main results: ksub(eff) and absorber worths agree within +- 2 promille Δk and +-2% $\Delta rho/rho$; flux and power distributions show small deviations of +-2% in the SNR-300 core with the small element pitch; they increase up to maximum values of about +- 10% in the fissile zones of SNR-2 (pitch of 17.0 cm); the computing time is reduced considerably.

61418 (INIS-mf—6845, pp vp) **Finite element application to global reactor analysis.** Schmidt, F.A.R. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The Finite Element Method is described as a Coarse Mesh Method with general basis and trial functions. Various consequences concerning programming and application of Finite Element Methods in reactor physics are drawn. One of the conclusions is that the Finite Element Method is a valuable tool in solving global reactor analysis problems. However, problems which can be described by rectangular boxes still can be solved with special coarse mesh programs more efficiently.

61419 (INIS-mf—6845, pp vp) **Finite elements in multidimensional nuclear diffusion.** Davierwalla, D.M.; Pelloni, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)); Altiparmakov, D. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Although structural engineering has produced a large variety of element types only triangular and quadratic elements of the Lagrangian seem to have caught on in nuclear fields. In this report we wish to stress two topics. The first is, certain shortcomings of the triangular element, when used to model problems which are essentially one dimensional such as slab-geometry. This forced us to introduce rectangular elements into the finite element diffusion code FINELM. As far as ksub(eff) or reaction rates are concerned there is perhaps little to choose between the two but point flux behaviour is distinctly superior for rectangular elements. After the initial enthusiasm about finite elements the writing of finite element codes seems to be on the wane. This is largely due to the irregular wide band structure of the resulting system matrix which pose acute problems for core management. In FINELM, which has been operational for about two years, we considered the number of degrees of freedom as a given quantity and solved the core management problem by using basic graph-theoretic ideas. In QUFEM, the Yougoslavian code, which is still largely in the experimental stage the problem is attacked by using large high order general quadrilateral elements extending over spatially varying (smoothly) cross sections as would occur in pebble bed reactors.

61420 (INIS-mf—6845, pp vp) **New finite element representation for 3D reactor calculations.** Lautard, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

New finite element representations are applied to light water reactor coarse mesh calculations. Two kinds have been implemented: (1) finite elements based on numerical integration at Gaussian points, (2) finite element based on non-conforming representations. The various methods are compared with other classical finite elements and with the finite difference method, on two 2D typical cores. Also, some numerical results are given for the 3D benchmark reactor. These results lead to computing times and accuracies on the power distributions which approach those obtained by the nodal synthesis method.

61421 (INIS-mf—6845, pp vp) **Global analysis of pressurized water reactors with hexagonal lattice.** Kulikowska, T. (Institute of Nuclear Research, Otwock (Poland). Swierk Research Establishment). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The present paper gives a review of numerical methods developed in the last few years for calculations of pressurized water reactors with a hexagonal lattice. The hexagonal lattice of the reactor core necessitates the application of a triangular or hexagonal mesh whose peculiarities influence the methods and formulas used. In many laboratories dealing with calculations of that type of reactors new approaches have been developed improving the accuracy of results or efficiency of calculations. Some of them are a generalization of methods developed previously for a rectangular geometry to hexagonal systems. There are also new techniques designed especially for hexagonal lattices. The emphasis is put on methods developed for VVER type of reactors which may not be widely known and present an original approach to the problem. Indications are also given concerning the implementation of proposed methods into computer programs.

61422 (INIS-mf—6845, pp vp) **Efficient methods of accelerating reactor diffusion codes.** Woznicki, Z.I. (Institute of Nuclear Research, Otwock (Poland). Swierk Research Establishment). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

In the paper it is shown that improving the efficiency of numerical solution of multi-dimensional neutron diffusion equations can be achieved in two ways. The first is concerned with using effective iterative methods for solving neutron diffusion equations. The second possibility results from introducing a new finite difference scheme obtained by some combination of 7-point difference formula with six 4-point formulae.

61423 (INIS-mf—6845, pp vp) **New iterative methods for CITATION code.** Andrzejewski, K. (Institute of Nuclear Research, Otwock (Poland). Swierk Research Establishment). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A new method for inner iterations and two methods for outer iterations were introduced into diffusion-burnup code CITATION to reduce the time consumed for iteration process by a factor of about 1.5.

61424 (INIS-mf—6845, pp vp) **Numerical computation of generalized importance functions.** Gomit, J.M.; Nasr, M.; Ngyuen van Chi, G.; Pasquet, J.P.; Planchard, J. (Electricite de France, 92 - Clamart. Direction des Etudes et Recherches:. 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Thus far, an important effort has been devoted to developing and applying generalized perturbation theory in reactor physics analysis. In this work we are interested in the calculation of the importance functions by the method of A. Gandini. We have noted that in this method the convergence of the iterative procedure adopted is not rapid. Hence to accelerate this convergence we have used the semi-iterative technique. Two computer codes have been developed for one and two dimensional calculations (SPHINX-1D and SPHINX-2D). The advantage of our calculation was confirmed by some comparative tests in which the iteration number and the computing time were highly reduced with respect to classical calculation (CIAP-1D and CIAP-2D).

61425 (INIS-mf—6845, pp vp) **Nodal method in hexagonal geometry.** Duracz, T. (Institute of Nuclear Research, Otwock (Poland). Swierk Research Establishment). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Two simple variants of an extension of the Nodal Expansion Method to the case of hexagonal geometry are presented. The method can be applied in a multigroup case and shows good accuracy as demonstrated in the paper.

61426 **(ORNL/TM—8185) User's guide for BAYES: a general-purpose computer code for fitting a functional form to experimental data.** Larson, N.M. (Oak Ridge National Lab., TN (USA)). Aug 1982. Contract W-7405-ENG-26. 213p. (ENDF—323). NTIS, PC A10/MF A01. Order Number DE82021092.

This report is intended as a user's manual for a general-purpose computer program BAYES to solve Bayes equations for updating parameter values, uncertainties, and correlations. Bayes equations are derived from Bayes theorem, using linearity and normality assumptions. The method of solution is described, and details are given for adapting the code for a specific purpose. Numerous examples are given, including problem description and solution method, FORTRAN coding, and sample input and output. A companion code LEAST, which solves the usual least-squares equations rather than Bayes equations but which encourages nondiagonal data weighting, is also described.

61427 **The gain from a mixed finite difference formulation for three dimensional diffusion theory neutronics.** Fowler, T.B.; Vondy, D.R. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **39**: 460-461(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61428 **A nodal interface current method for multigroup diffusion calculations in hexagonal geometry.** Lawrence, R.D. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **39**: 461-462(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61429 **Finite difference effects in the synthetic acceleration method.** Gelbard, E.M.; Larsen, E.W.; McCoy, D.R. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **39**: 462-463(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61430 **A comparision of linear nodal, linear discontinuous, and diamond schemes for solving the transparent equation in (x,y) Geometry.** O'Dell, R.D.; Walters, W.F. (LANL, Los Alamos, NM 87544). *Transactions of the American Nuclear Society;* **39**: 465-467(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61431 **Benchmark testing of anisotropic diffusion coefficients for multigroup slab lattice cells.** Gelbard, E.M.; McCoy, D.R. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **39**: 467-469(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61432 **An unconditionally stable acceleration method for arbitrary weighted differencing schemes.** Larsen, E.W.; McCoy, D.R. (LANL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **39**: 469-471(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61433 **Time absorption eigenvalue searches for subcritical systems.** Hill, T.R. (LANL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **39**: 471(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61434 **Fokker-Planck calculations using standard discrete-ordinates transport codes.** Morel, J.E. (Sandia, Albuquerque, NM 87185). *Transactions of the American Nuclear Society;* **39**: 488(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61435 **The stability of various alternative coolant-heat-transfer computational techniques.** Gelboard, E.M.; Hofman, J.R. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **39**: 493-494(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61436 **Improved coupling of the conduction and flow and equations in TRAC.** Addessio, F.L. (LANL, Livermore, CA 94550). *Transactions of the American Nuclear Society;* **39**: 494-495(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61437 **Iterative solution of the fully implicit HEM equations.** Gelbard, E.M.; Hofmann, J.R. (ANL, Argonne, IL 60436). *Transactions of the American Nuclear Society;* **39**: 503-504(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61438 **An improved scheme for a two fluid model in COMMIX-2.** Domanus, H.M.; Miao, C.C.; Schmitt, R.C.; Sha, W.T.; Shah, V.L. (ANL, Argonne, Il 60439). *Transactions of the American Nuclear Society;* **39**: 508-509(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61439 **A phase-boundary search process for controlling time step size.** Gelbard, E.M.; Hofmann, J.R. (ANL, Argonne, Il 60439). *Transactions of the American Nuclear Society;* **39**: 509-510(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61440 **A new porous media approach for thermal-hydraulic analysis.** Sha, W.T. (ANL, Argonne, Il 60439). *Transactions of the American Nuclear Society;* **39**: 510-512(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

2202 Components And Accessories

REFER ALSO TO CITATION(S) 61555, 61755

61441 **(ORNL-tr—4864) Transmitter dynamics: final report from a preliminary study of the dynamic properties of a level measurement system at a nuclear power plant.** Egardt, B. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. Translation source information not available . 54p. NTIS, PC A04/MF A01. Order Number DE82021912.

Portions of document are illegible.

The description of the level measuring system may be divided into two parts. One part consists of a description of the system under normal operating conditions. A combination of physical models and experimental results has been used for this purpose. The other part deals with the behavior of the measurement system under abnormal operating conditions and, in this case, the results are based on physical models alone. This report presents the results of the study according to the following scheme: section 2 presents a statement of the problem; models for normal and abnormal operating conditions are presented in sections 3 and 4; the measurement principle itself is discussed in section 5; and section 6 summarizes the conclusions of the project.

61442 **(CNEN-DR—88/80) Preliminary evaluation of the stress analysis reports for Angra I reactor coolant loop - part 1.** Ribeiro, S.V.G.; de Andrade, J.E.L.; Heeschen, U. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). Mar 1980. 140p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82702668.

A methodology that will allow CNEN to approve the stress analysis reports of the components of the Brazilian nuclear power plants, was developed. The reactor coolant loop (RCL)of Angra I was checked. This is the first part of the complete report and consists of the approval of the design documents, the approval of the equipment support models and the approval of the steam generator dynamic model. The second part of this work is under way now and should contain the approval of the RCL stress and fatigue analysis according to ASME code section III. As shown in section 7 it appears necessary additional information from Westinghouse about the design of the RCL.

61443 **(CONF-810801—92) Biaxial model for bounding creep ratchetting in shells.** O'Donnell, W.J.; Porowski, J.S. (O'Donnell and Associates, Inc., Pittsburgh, PA (USA)). 1981. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01. Order Number DE82020939.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

Portions of document are illegible.

The concept of elastic core stress is used to derive bounds for the maximum inelastic strains in shells of revolution subjected to pressure and cyclic thermal loads in the creep regime. Solutions are obtained for primary membrane stresses of arbitrary biaxiality and thermal bending of arbitrary biaxiality. The stress regimes where previously derived uniaxial solutions can be conservatively used are defined. The new biaxial solutions provide more efficient bounds than the uniaxial solutions for the maximum strains in pressurized spheres and cylinders.

61444 **(EPRI-NP—2099-Vols.1-3) DUVAL: a computer program for the numerical solution of two-dimensional, two-phase flow problems. Final report.** Dougall, R.S.; Hall, C.A.; Porsching, T.A. (Pittsburgh Univ., PA (USA)). Apr 1982. 226p. NTIS (US Sales Only). Order Number DE82904049.

Portions of document are illegible.

This report documents the models, methods, usage and results of the DUVAL computer program developed for the solution of two-dimensional, thermally expandable flow. Specific applications of the code are in the study of two-dimensional, two-phase flow behavior in steam generators. The report is divided into three volumes as follows: (1) the mathematical models and numerical methods; (2) the DUVAL user's manual; and (3) the DUVAL programmer's manual.

61445 **(FEI—1200) Hydrodynamics in a inhomogeneous porous medium. Part 1. Specific features of the equations of motion.** Yur'ev, Yu.S.; Vladimirova, L.I.; Komyshnaya, G.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702648.

Derivation of equations of averaged liquid flow in a porous medium possessing structure inhomogeneities (porosity resistance) with sharp boundaries is presented. The resulting system of equations is split into two systems: that for a boundary region and for the rest space. Derivation of the equations of averaged liquid flow in an inhomogeneous anisotropic porous body with sharp boundaries of inhomogeneities has shown that near the boundaries additional local resistance forces and local inertia forces connected with abrupt change in the body structure act on the liquid. These boundary effects approximately may be taken into account by means of a proper hydraulic resistance coefficient increase in the boundary region. The system of equations derived may be used for calculating the open hydraulic curcuit of a reactor or heat exchanger including "collector-lattice-porous zone-lattice-collector".

61446 **(FEI—1201) Hydrodynamics in a inhomogeneous porous medium. Part 2. On contingency conditions for liquid flows on the boundary between different porous bodies.** Yur'ev, Yu.S.; Vladimirova, L.I.; Bobkova, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702649.

Averaged equations of liquid flow in an inhomogeneous anisotropic porous body and contingency conditions for the flow on the boundary between different porous bodies namely equality of normal filtration rate component and that of full pressures are considered. On analytical examples abrupt-like pressure and rate changes and current line gradient on the boundary between two porous bodies are illustrated. The cases of the slanting liquid inflows on the porous layers and pressure drop on a porous lattice are considered. The results are compared with experimental data. From the condition of full pressure equality some specific types of boundary conditions recommended for approbation in numerical calculations of liquid flow for example, in reactors and heat exchangers are derived. Precise solutions which can be used as testing versions during numerical calculations are obtained.

61447 **(FEI—1204) Use of a conditional parameter in burnout calculations in the case of in non-uniform thermal load along the length and under nonstationary conditions.** Pomet'ko, R.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702651.

An approach to the description of burnout in fuel channels using a certain parameter called conditional is suggested. It is supposed that such parameter denoted by phi determining the conditions of burnout begin existis and the burnout arises when phi reaches a certain limiting value phisub(cr). For the dispersering fluid flow phi may be identified with the film liquid flow rate. For subheated liquid may be identified with true steam content. phi may be treated as the fluid density in the wall layer. phi may present a combination (even if unknown) of different parameters. It is assumed that the limiting value of phi is conservative in relation to the law of heat generation by length and to nonstationary conditions. phi is measured continuously along the channel length. It is shown that the introduction of such parameter as phi allows to obtain satisfactory calculational accuracy for the value of critical power of channels with non- uniform heat release along the length without introduction of any empirical coefficients. The possibility of using the above parameter is demonstrated and dependences for burnout calculation under nonstationary conditions are given. It is shown that the results of burnout calculations are independent of initial and finite values of the parameter. The law of phi variation along the channel length either does not affect or slightly affects the calculational results.

61448 **(FEI—1210) Coefficient of proportionality between electromagnetic transducer signal and coolant local velocity in different shape channels.** Mikhin, V.I.; Zhukov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702652.

The results of calculating the dectromagnetic transducer signal used for investigating the hydrodynamics of liquid metal coolants in nuclear reactor model fuel assemblies are presented. The calculations are carried out for channels of triangular, square and hexahedral configurations as well as for cells of infinite fuel element lattices and for eccen tric annular channels. The problem of the channel configuration effect on the proportionality coefficient K between the transducer signal and the coolant velocity is investigated. Dimensions of the transducer magnet are chosen in such a way that K does not depend on the pitch of the infinite fuel element lattice. The transducer signals in infinite fuel element lattices are calculated for turbulent and laminar coolant flows. Calculations for other channels are performed for turbulent coolant flow with two values of the Reynolds number. It has been elucidated that the proportionality coefficients K averaged over angle are equal for the investigated channels of triangular and square configurations, eccentric rings and for hexahedral channel. K is in dependent of the transducer orientation angle (with 10% accuracy) for all channels under investigation.

61449 **(FEI—1218) Temperature pulsations caused by jet oscillations in flow between lattices.** Burakov, B.G.; Kovaleva, V.V.; Nomofilov, E.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702653.

For the purpose of studying the processes in fast reactor heat exchangers the nonuniformly heated liquid flow in a rectangular volume limited by solid side walls and inlet and outlet lattices is numerically simulated. The liquid temperature and its change on solid walls and inside the volume are calculated. At the inlet a parabolic velocity profile has been prescribed for each of the openings. At the outlet the flow rate through each of the lattice openings has been calculated by the boundary layer equation. As calculations show the values of local flow rates through a single opening may vary in wide limits from negative (liquid inflow) to large positive values. In order to evaluate the effects of flow rate and velocity pulsations on the temperature variations in the lattice system the thermal and hydrodynamic problems have been solved. A nonstationary pulsating solution is obtained. The thermal problem with temperature burst at an inlet is considered as well. The outlet temperature spot variation and jet temperature equalization are analyzed. It is shown that the temperature profiles repeat liquid jet oscillations. For the system of lattices with five inlet openings and four outlet ones temperature variations constitute approximately 25%. Pulsations are of periodic character.

61450 **(FEI—1236) Interaction between jets in a volume in the case of mixed convection.** Burakov, B.G.; Opanasenko, A.N.; Shan'gin, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702656.

The numerical solution of the Navier-Stokes equation and experimental data of visual investigations of propagation and interaction of unequally heated jets in a cold liquid in a limited volume are qualitatively compared in the study. It has been assumed in the experiments and calculations that Re=74, Pe=400, Fr=10^{-3}, 10^{-4}. The calculational area amounts to 30x42, counting times are of the order of an hour for the BESM-6 computer. Temperature fields and flow functions are close to the liquid flow structure profiles obtained by the shadow method. This coincidence indicates a principle possibility of numerical simulation of studied flows.

61451 (INIS-mf—6714, pp vp) **Construction of a computer program to calculate the dynamics of fluids.** Stuhmiller, J.H.; Vander Vorst, M.J. (Energy Research and Development Administration, Washington, DC (USA). Office of University Programs). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

61452 (INIS-mf—6845, pp vp) **Numerical simulation of the fluid flow in a centrifugal steam separator.** Vander Vorst, M.J.; Stuhmiller, J.H. (JAYCOR, San Diego, CA (USA). Fluid Dynamics Div.); Steininger, D.A. (Electric Power Research Inst., Palo Alto, CA (USA)). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The nature of the fluid flow within a primary centrifugal steam separator was previously only speculated. The Electric Power Research Institute ist now sponsoring numerical and experimental programs to quantify the two-phase fluid flow within seperators. In this paper we present results from the numerical simulation of the three-dimensional, axially symmetric, two-phase fluid flow within and about a centrifugal steam separator. This flow is non-homogeneous and exhibits phase separation due to both centrifugal and gravitational forces. We also present descriptions of the analytical and computational models used in this study. The computer code, SWIRL, developed under this effort is an adaption of the EITACC (Equation-Independent-Time-Averaged-Conformal-Coordinates) code for this problem. The SWIRL code is able to simulate several manufactures' designs within the generic class of centrifugal steam separators. This computer program calculates all three components of both the steam and water velocities, the void fraction, and the pressure at discrete points both within and outside of a separator. These results are then used to quantify the performance of the separator.

61453 (INIS-mf—7043, pp 5) **Ion thermometers - nuclear reactor applications.** Rosenkranz, J.; Jakes, D. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1980. (In Czech). NTIS (US Sales Only), PC A02/MF A01.

From 8. seminar on ceramic solid electrolytes; Hradec Kralove, Czechoslovakia (14 Apr 1980).

The principle is briefly described of ion thermometers and the effects are reported of radiation on the ion crystal properties. The results show that ion thermometers are applicable for in-core measurements.

61454 (INIS-SU—18, pp 3-9) **Experimental study of hydrodynamics and heat transfer crisis in horizontal steam generating channels with a porous insertion.** Styrikovich, M.A.; Leont'ev, A.I.; Mostinskij, I.L.; Polonskij, V.S.; Chernika, I.M. (AN SSSR, Moscow. Inst. Vysokikh Temperatur:. 1980. (In Russian). Dep. NTIS (US Sales Only).

From 4. all union conference on heat-masstransfer; Minsk, Byelorussian, USSR (Sep 1980).

Results of experimental investigations into critical heat flows qsub(cr) and hydraulic resistance in horizontal tubes with the capillary-porous coating of walls are presented. An experimental section was made of a steel tube of 10x2 mm diameter, a filter core closely pressed to the inner surface of tube was used as the coating. The experiments were carried out at 6.86, 9.81, 13.73 MPa pressures and current mass velocities of 1000 and 2000 kg/(m^{2}xs). Critical mass steam content varied from -0.2 to 1.0, thermal load - 0.70 -4.10 MW/m^2. The experimental data are presented in the form of qsub(cr) parametric dependence of critical density of heat flow on X mass steam content in the crises section at constant values of velocity and pressure. The application of a porous insertion as an intensifier in a steam generating channel turned out more effective in the range of great mass velocities and positive steam contents. The porous structure considerably increases the critical steam content and widens the range of crisis-free operation. Hydraulic resistance when flowing two-phase current in the channel with the porous insertion was studied under adiabatic canditions. It is shown that the hydraulic resistance in the channel with the porous insertion is satisfactorily described with a set of equations for a homogeneous two-phase current.

61455 (LCC—013/80) **Stress in different 'toriesfericas' pressure vessels'lids.** Taroco, E.; Feijoo, R.A. (Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil)). Dec 1980. 19p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702665.

The effect produced by 'toriesfericas' lids on the state of stress and deformation of pressure vessels made of isotropic elastic material is presented.

61456 (LCC—014/80) **Multiple excitation of supports - Part 1. Formulation.** Galeao, A.C.N.R.; Barbosa, H.J.C. (Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil)). Dec 1980. 26p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702666.

The formulation and the solution of a simple specific problem of support movement are presented. The formulation is extended to the general case of infinitesimal elasticity where the approximated solutions are obtained by the variational formulation with spatial discretization by Finite Element Method. Finally, the present usual numerical techniques for the treatment of the resulting ordinary differential equations system are discused: Direct integration, Modal overlap, Spectral response.

61457 (LCC—015/80) **Multiple excitation of supports - Part 2 : Implementation in TUBO system.** Galeao, A.C.N.R.; Barbosa, H.J.C. (Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil)). Dec 1980. 20p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702667.

From the formulation of multiple excitation support problem, discussed in the first part of this work, and with the use of numerical techniques presented there, we discuss in this second part, the implementation in TUBO system, the follow procedure: Direct integration, Modal overlap, Spectral response emphasizing the aspects related to supports excitation. Finally, we present two numerical examples of TUBO system utilization in the solution of support movement problem. The several implemented computational procedures are compared.

61458 (LCC—016/80) **Pipeline dynamics subject to restraints with clearance.** Loula, A.F.D.; Guerreiro, J.N.C. (Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil)). Dec 1980. 19p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702659.

The principle of virtual works at its incremental form, is utilized for the formulation of flat pipeline vibration problems, of elastic-plastic behavior, submitted to restraints with clearance (also with elastic-plastic behavior) and with viscous damping. The possibility of uniform movement of the support, that simulates the seismic action is also considered. The finite element method and an integration time algorithm, are utilized for the problem resolution. Some examples ilustrate the application of the development program.

61459 (LCC—018/80) **Perturbed panel flutter: a simple model.** Sinay, L.R.; Reiss, E.L. (Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil)). Dec 1980. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702658.

The effects of small periodic disturbances on the response of a two-degree-of-freedom, non-conservative, mechanical system are analyzed. The system is a simple model for panel flutter. The disturbance simulates the pressure fluctuations of a turbulent boundary layer on the panel. Asymptotic expansions of the solutions are obtained for small amplitude disturbances. The qualitative features of the response depend on the prescribed variation of the disrurbance frequency with the magnitude of the non-conservative applied force. The disturbance can induce a smooth transition to the fluttering states of the rods; or it may induce jump transitions. The results suggest a possible technique for delaying panel flutter, by applying periodic forcing functions with appropriate frequencies.

61460 (NUREG/CR—2409) Requirements for establishing detector siting criteria in fires involving electrical materials. Boccio, J.L. (Brookhaven National Lab., Upton, NY (USA)). Aug 1982. Contract AC04-76DP00789. 51p. (SAND—81-7168). NTIS, PC A04/MF A01 - GPO.

Portions of document are illegible.

Due to increased public awareness and regulatory actions, significant strides have been made in the capabilities of fire technology as it applies to fire detection systems. However, these advances in detector selection, siting, reliability and approvals tests have not substantially addressed the overall fire protection requirements within nuclear reactors. This report emphasizes some of the basic requirements and considerations needed for establishing siting criteria for early-warning detection of electrical cable fires. Recent research in electrical cable flammability and damageability characteristics are discussed. Also current work in systemizing detector siting criteria is also described. Confirmatory tests linking assessment of electrical-cable damageability with electrical cable fire detection is stressed.

61461 (NUREG/CR—2868) Aging effects on fire-retardant additives in organic materials for nuclear-plant applications. Clough, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 35p. (SAND—82-0485). NTIS, PC A03/MF A01 - GPO.

Inhibiting fire is a major concern of nuclear safety. One of the most widely used commercial fire-retardant additives incorporated into cable insulation and other organic materials to reduce their flammability has been the halocarbon (usually a chlorinated hydrocarbon), typically in combination with antimony oxide. Such materials may be installed for the design lifetime of a nuclear plant; this report describes an investigation of the long-term aging behavior of these fire-retardant additives in polymeric materials. Extensive aging experiments on fire-retarded formulations of ethylene propylene rubber (EPR) and of chlorosulfonated polyethylene (CSPE) have been carried out, with chemical analysis of halogen and antimony content performed as a function of aging time and conditions. Oxygen index flammability measurements were also performed on selected samples. Significant fire-retardant losses (both chlorine (Cl) and antimony (Sb)) were found to occur in certain of the fire-retardant materials but not in others, depending on the molecular structure of the particular halogen-containing component. The data indicate that the loss of halogen- and antimony-based fire retardants appears to be insignificant under ambient conditions expected for nuclear plants.

61462 Component decontamination. Allen, R.P.; FitzPatrick, V.F. (PNL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **38**: 626-627(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61463 Steam generator transport: Surry, Virginia to Hanford, Washington. Clark, R.A.; PitzPatrick, V. (PNL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **39**: 826-827(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

2203 Fuel Elements

REFER ALSO TO CITATION(S) 60951

61464 (FEI—1203) Study on temperature fields and heat transfer in narrow lattices of water-cooled fuel-element simulators. Zhukov, A.V.; Muzhanov, A.B.; Ushakov, P.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702650.

The results of experimental study of temperature and heat transfer coefficient distributions in narrow lattices of longitudinally water cooled fuel element simulators are presented. The fuel element simulator clusters with various relative pitches ($1.0.1 <= s/d <= 1.06$) at different relative simulator wall thickness ($0.38 <= xi <= 0.95$) and equivalent heat transfer parameters are investigated. Here, S is the distance between the fuel element simulator centers d is external fuel element simulator diameter $xi = R_1/R$, where R and R_1, are external and internal simulator radii. The clusters consist of 19 or 61 simulators encased in a hexahedral or circular shrouds. The simulators are spaced by upper and lower lattices. The simulators are heated by heaters assuring on simulator internal surfaces the condition of q=const. The formulas for maximum temperature non-uniformities and Nusselt numbers which demonstrate the effects of equivalent fuel element simulator heat transfer, lattice pitch and Reynolds numbers on temperature profiles and heat transfer coefficients are given. The experimental data essentially differ from the calculational results available in the considered field. Data on the shroud influence on the simulator temperature profiles near the walls are presented.

61465 (FEI—1221) Vibrations of fuel elements caused by coolant flow pulsations in nuclear reactors. Kumaev, V.Ya.; Leonchuk, M.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702654.

The technique and results of calculation of nuclear reactor fuel element vibrations caused by non-uniform pulsating coolant flow are described. The reactor core being a regular fuel element cluster enclosed in a cylindrical shroud is considered. Mechanical effects of the irregular and non-stationary coolant flow, which is caused by big vortices existing in the reactor pressure chamber are taken into account. The coolant velocity profiles in the core are calculated on the basis of solving the linearized equations of anisotropic filtration. The calculation of fuel element vibration amplitudes is based on solving the equation of vibrations of elastic rod with a free hinged ends. On the base of the analysis of obtained results it is concluded that distribution of stresses and bendings over the fuel element height are close to sinusoidal ones.

61466 (FEI—1222) Technique for numerical solution of the equation of rod oscillations in a liquid flow. Leonchuk, M.P.; Sivak, Z.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702655.

Numerical method for solving the equation of single rod vibrations in liquid flow for different boundary conditions is suggested. Exact and approximated solutions for free vibrations of a fixed rod having an initial deflection vibrations resulted from the rod loading by uniformly distributed force, vibrations under the effect of periodically changing force non-uniform along the rod length are compared. The method may be used for calculating vibrations of fuel elements and heat exchanger tubes.

61467 Critical heat flux predictions based on the BODY-FIT-2PC computer code. Chen, B.C.; Chien, T.H.; Kim, J.H.; Sehgal, B.R.; Sha, W.T. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **38**: 767-768(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61468 Techniques for resolving double failures of xenon-tagged fuel elements. Gross, K.C. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **39**: 500-501(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61469 Thermal-mechanical properties of cracked UO2 pellets. Williford, R.E.; Lanning, D.D.; Mohr, C.L. (BNWL, Richland, WA 99352). *Transactions of the American Nuclear Society;* **35**: 342-343(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61470 **RERTR program generic studies.** Matos, J.E. (Argonne National Lab., IL). *Transactions of the American Nuclear Society, Supplement;* **32**: 29-30(1979). (CONF-790807—).

From Topical conference on reactor operating experience; Arlington, TX, USA (5 Aug 1979).

61471 **RERTR program fuel demonstrations: a status report.** Snelgrove, J.L. (Argonne National Lab., IL). *Transactions of the American Nuclear Society, Supplement;* **32**: 30(1979). (CONF-790807—).

From Topical conference on reactor operating experience; Arlington, TX, USA (5 Aug 1979).

2204 Control Systems

61472 **(CEA-CONF—6034) Measurements and simulations of electromagnetic perturbations on neutronic and thermodynamic control systems of nuclear reactors.** Lecompte, J.C.; Buisson, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Electronique et d'Instrumentation Nucleaire). Jan 1981. 7p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702478.

From National meeting on electromagnetic compatibility; Lille, France (27 - 29 Jan 1981).

Neutronics and thermodynamics measuring devices realize the control and nuclear safety of the reactor and the core. They cause the emergency stop of the reactor if the informations given by the sensors are out of the normal operation tolerances. Defining and assuring a protection level sufficiently high against electromagnetic disturbances is essential for avoiding those measuring devices of giving erroneous indications in the environment where they are located. To obtain this result, one procceds according to the following three steps: a) In situ measurements of the ambient level of disturbances (oscilloscope analysis, statistical measurements). b) Measurement in laboratory of the immunity against the disturbances caused by every constituent of the device (electronic cables, connectors) and then the complete device. c) In situ simulation on the devices of the perturbations caused by the measured ambient level.

61473 (INIS-mf—6714, pp vp) **Multivariable feedback control applications in combustion engineering high power density pressurized water reactors.** Bollacasa, D. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems); Busi, T. (Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Automatica). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The Multivariable Frequency Response technique was used to design a control system for Pressurized Water Reactors. The technique is based on a generalization of the frequency response approach to control system design. The aim of the study was to evaluate the feasibility of automatic control of Pressurized Water Reactors of Combustion Engineering design. The objectives for the design of the control system were to maintain core parameters within their design limits, eliminate boron over- and undershoots during load changes, emphasize axial shape control when approaching rated power, reduce control rod motion and permit deviations from the primary coolant temperature program where practical. The performance of the simulated control system was evaluated using a model of a Nuclear Steam Supply System with a 3-dimensional nodal reactor core representation. An analysis of PWR load changes showed that the power distribution and the average reactor coolant temperature can be adequately controlled automatically. The performance of the simulated control system for a variety of core conditions, demonstrated the potential usefulness of automatic multivariable feedback control in Pressurized Water Reactors.

61474 (INIS-mf—6714, pp vp) **Power distribution control by hierarchical optimisation techniques.** Beraha, D.; Karppinen, J. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Formulation of the power distribution control problem as an optimal control problem with an extensive set of constraints classifies as a large scale problem. Centralized solution schemes employed until now have required simplifications in the control scope or core description in order to be practicable. However, the problem structure is particularly well suited for application of hierarchical solution methods employing decomposition and coordination techniques. These techniques can be utilized to considerably reduce the computational effort required for solution. A more comprehensive control scope and a more realistic core description are therefore feasible with new solution methods. Two closely related hierarchical multi-level solution schemes are presented in this paper. They allow a non-linear, three dimensional core model with a large number of nodes, control and state variable constraints (e.g. constraints on local power densities) and a predictive multi-stage control scope. Two control or operation modes are aimed at with the new solution approaches: a long term predictive control mode and a short term feedback control mode. Numerical results obtained on a reactor core simulator demonstrate the efficiency of the hierarchical approach to the structured large-scale power distribution control problem.

61475 **(ORNL/TM—8111) Monte Carlo calculations of control-rod worth of a medium-size pebble-bed reactor.** Tang, J.S.; Worley, B.A. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01. Order Number DE82021110.

Three-dimensional full-core control-rod worth calculations by the Monte Carlo method are performed for a 1640 MW(t) pebble-bed reactor. The worths of all control rods at several insertions are investigated. The reactivity provided by the control rods in the 1-meter void above the core is about 3% and a 20% negative reactivity can be obtained by axially inserting all control rods 3/4 into the reactor core. The multigroup KENO Monte Carlo code with a six-group neutron cross-section library was used in the calculations.

61476 **Designing for man: advances in control room operation.** Lihach, N.; Cain, D.; Loewenstein, W.; Long, A.; O'Brien, J.; Parris, H.; Rossin, A.D.; Rubio, A. *EPRI (Electric Power Research Institute) Journal;* **7**: No. 6, 6-13(Jul 1982).

Power plants are made up of hardware, but they are operated and maintained by humans. Since Three Mile Island, the role of human factors in safe and economic power generation has been more fully appreciated. Control board displays, alarm systems, procedures, and even the space allotted for making repairs are all under industry study. Many of the improvements will be retrofits because so few new plants are being built. An effort will be made to pace regulatory changes and train operators with simulators so that the rate of change doesn't become a major problem. 7 references, 2 figures.

61477 **Postirradiation examination and performance of hafnium as a control rod material.** Beeston, J.M. (EG&G Idaho, Idaho Falls, ID 83415). *Transactions of the American Nuclear Society;* **39**: 399-400(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 61311, 61522, 61530, 62049

61478 **Off-gas handling at TMI-escape of radioactivity and implications for the future.** Broksbank, R.E.; Campbell, D.O.; King, L.J. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **38**: 499-500(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 61346

61479 **(CEA-CONF—6026) Silene reactor: an irradiation facility.** Barbry, F.; Medioni, R. (CEA Centre d'Etudes de Valduc, 21 - Is-sur-Tille (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Jun 1981. 13p. (In French). (CONF-810673—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702675.

From 4. symposium on neutron dosimetry; Munich-Neuherberg, F.R. Germany (1 Jun 1981).

The experimental reactor SILENE is an original neutron and gamma radiation source because of the large range of its possibilities and the core features. The core, a small size annular vessel (36 cm diameter), is fueled with a uranyl nitrate solution. The great flexibility of this type of fuel allows to operate the reactor in three modes: The pulse operation at high level power (1000 Megawatts) in a short time (6 ms); the free evolution operation (simulation of criticality accidental excursions); and the steady state operation with a range of power level included between 1/100 watt and 1 kilowatt. Moreover the core can be surrounded by adequate shields (lead, iron, hydrogeneous material) to vary the characteristics of leakage radiations. The reactor which is located in a large concrete room is capable to provide integrated doses up to 10^4 rads at 1 m, either in a short time, either in a large scale time (several hours). The main characteristics regarding to the radiation field and the measurement techniques are given in this paper. The applications of such a source are outlined. It concerns mainly health physics studies (dosimetry, radiobiology), nuclear safety studies (criticality alarm tests, criticality accidents, equation of state of fuels) and the other applications of thermal neutrons such as neutron radiography.

61480 **(CTA-EAV—008/80) Linear and nonlinear stability analysis, associated to experimental fast reactors. Part 1.** do Amorim, E.S.; de Moura Neto, C.; Rosa, M.A.P. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Atividades Espaciais). Jul 1980. 57p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82702670.

Phenomena associated to the physics of fast neutrons were analysed by linear and nonlinear Kinetics with arbitrary feedback. The theoretical foundations of linear kinetics and transfer functions aiming at the analysis of fast reactors stability, are established. These stability conditions were analytically proposed and investigated by digital and analogic programs.

61481 **(CTA-EAV—018/80) Experimental fast reactors: self sustained symetric and asymetric oscillations and viability as a source of pulse neutrons.** do Amorim, E.S.; de Moura Neto, C.; Rocamora Junior, F.D. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Atividades Espaciais). Nov 1980. 60p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE82702672.

A stability criterion was established beginning from the transfer functions to the 'zero power' and feedback. Through an analogical simulation of effects referring to the reactivity periodical insertion with wide amplitude, oscillation treatment introduced by radial movements of the fuel element and eigen-supported oscillations were studied. The possibility of as a reactor operating as a source of pulsed neutrons was established through a non linear treatment. The stability of reactor working in this system was studied embracing harmonics of elevated order.

61482 **(HW—73457) Tabular values of reactivity vs. period, and reactivity corrections for use in PCTR and TTR experiments.** Nichols, P.F. (General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation). 23 Apr 1962. Contract AC06-76FF02170. 41p. NTIS (US Sales Only). Order Number DE82021370.

Portions of document are illegible.

New tables of reactivity vs. period have been generated for use in PCTR and TTR experiments using the IBM-7090 program, Period-Reactivity. Tables have been prepared for various combinations of the delayed fraction β, and the prompt lifetime l.

61483 (INIS-mf—6714, pp vp) **EBRPOCO - a program to calculate detailed contributions of power reactivity components of EBR-II.** Meneghetti, D.; Kucera, D.A. (Argonne National Lab., IL (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The EBRPOCO program has been developed to facilitate the calculations of the power coefficients of reactivity of EBR-II loadings. The program enables contributions of various components of the power coefficient to be delineated axially for every subassembly. The program computes the reactivity contributions of the power coefficients resulting from: density reduction of sodium coolant due to temperature; displacement of sodium coolant by thermal expansions of cladding, structural rods, subassembly cans, and lower and upper axial reflectors; density reductions of these steel components due to temperature; displacement of bond-sodium (if present) in gaps by differential thermal expansions of fuel and cladding; density reduction of bond-sodium (if present) in gaps due to temperature; free axial expansion of fuel if unrestricted by cladding or restricted axial expansion of fuel determined by axial expansion of cladding. Isotopic spatial contributions to the Doppler component my also be obtained.

61484 (NUREG/CP—0031-Vol.1, pp 243-256) **SILOETTE, a training centre for reactor physics at the Nuclear Research Centre of Grenoble, France, France.** Destot, M. (Centre d'Etudes Nucleaires de Grenoble). Jun 1982. NTIS, PC A12/MF A01 - $9.50.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

Located at the Nuclear Research Centre of Grenoble, SILOETTE is a pool type reactor with a power of 100 kW. Designed as a nuclear model for the testing reactors SILOE and MELUSINE, both installed at the same site, SILOETTE has also been used for other applications, involving: either its use as a neutron source (in the core as well as on beam tubes); or its utilization as a training reactor, associated with an electro-nuclear power station simulator. In any case, the latter application constitutes nowadays the main activity linked to the reactor SILOETTE. It is exercised in connection with the French National Electricity Authority (ELECTRICITE DE FRANCE - EDF).

61485 **EBR-II-16 years of successful operation with a pool-type reactor.** Perry, W.H.; Richardson, W.J.; Sackett, J.I. (ANL-Idaho, Idaho Falls, ID 83401). *Transactions of the American Nuclear Society;* **38**: 606-607(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61486 **FFTF operations: 1980-a year of achievement.** Bliss, R.J.; Newland, D.J. (Westinghouse Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **38**: 610-611(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61487 **Analysis of in-core coolant temperatures of FFTF instrumented fuels tests at full power.** Hoth, C.W. (Westinghouse Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **38**: 753-755(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61488 **Thermal-hydraulic analysis of the FFTF core using SUPERENERGY-2.** Cramer, E.R. (Westinghouse-Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **38**: 764-765(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61489 **FFTF primary heat transport HVAC system.** Hicks, D.F.; Schweiger, D.L.; Umek, A.M. (Westinghouse Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **39**: 700-701(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61490 **HFEF preparations for FFTF Element, Capsule, and subassembly examinations.** Bacca, J.P.; Coomer, P.L.; DiLorenzo, F.L.; McClurkin, J.L.; Phipps, R.D.; Rovig, M.D. (ANL-Idaho, Idaho Falls, ID 83401). *Transactions of the American Nuclear Society;* **39**: 963-965(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61491 **A high temperature neutron shield.** Bower, J.M.; White, E.R. (EG and G Idaho, Idaho Falls, ID 83415). *Transactions of the American Nuclear Society;* **39**: 809-810(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61492 **Comparison of calculations with neutron dosimetry measurements performed at the Oak Ridge poolside facility.** Maeker, R.E.; Williams, M.L. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **39**: 812-813(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61493 **Analysis of the ORNL-TSF radial blanket and shield integral experiment.** Williams, L.R. (Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **35**: 470-472(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61494 **Application of ANSI/ANS-5.1-1979/HEAT 5 Code to LOFT technical specifications.** Hanson, G.H.; Atkinson, S.A.; Tasaka, K. (EG&G Idaho, Idaho Falls, ID 83415). *Transactions of the American Nuclear Society;* **35**: 337-338(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

2207 Plutonium And Isotope Production Reactors

61495 **(ORNL/TM—8349) High flux isotope reactor. Quarterly report, January-March 1982.** Corbett, B.L.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Jun 1982. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE82016581.

Routine reactor operation with four end-of-cycle shutdowns and one scheduled shutdown for training purposes resulted in an on-stream time of 92.1% for the quarter. The outer control plates were changed. The control plate track guide bearings, the control plate extension tubes, and the shock absorbers were replaced and a semiannual core component inspection was made. Cracks were discovered in the outermost ring of the beryllium reflector.

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 61109

61496 **(PB—82-185240) Merchant vessel advanced power systems. Final report.** Baham, G.J.; Swensson, G. (Baham Corp., Columbia, MD (USA)). Jan 1982. 212p. NTIS, PC A10/MF A01.

This study identifies and evaluates potential highly advanced propulsion power plants which may have marine applications beyond the year 2000. Various promising current technologies were screened and an evaluation of each plant concept and its suitability for use as a merchant ship propulsion system is contained in this report.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 61364, 61370, 61371, 61372, 61435, 61629, 62131

61497 **(BNL-NUREG—31623) Dynamic behavior of a subcooled BWR core during a rod-drop accident.** Cokinos, D.; Carew, J. (Brookhaven National Lab., Upton, NY (USA)). Jun 1982. Contract AC02-76CH00016. 7p. (CONF-821103—21). NTIS, PC A02/MF A01.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

The techniques and models used in the study of rapid reactivity insertion in a BWR have ranged from approximate conservative methods with simple feedback models to detailed representations of coupled neutronic thermal-hydraulic mechanisms. In a recent paper Cheng and Diamond presented a detailed evaluation of the control rod drop accident (CRDA). Their calculations suggested that the effect of inlet subcooling and rod drop speed may play an important role in determining the severity of the rod drop accident. The purpose of the work summarized in this paper has been to determine in detail the dynamic behavior of a BWR core as the inlet moderator temperature and the speed of the dropped rod are varied.

61498 **(BNL-NUREG—31679) Analysis of loss-of-flow transients in a pool-type LMFBR using SSC-P.** Madni, I.K.; Cazzoli, E.G. (Brookhaven National Lab., Upton, NY (USA); University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Mechanical Engineering). 1982. Contract AC02-76CH00016. 10p. (CONF-820704—27). NTIS, PC A02/MF A01.

From International topical meeting on LMFBR safety; Lyon, France (18 Jul 1982).

In order to have a general analytical capability for the safety evaluation of any proposed LMFBR system, the USNRC is sponsoring the development and validation of computer codes for both pool- and loop-type plants. The computer code for pool-type LMFBRs is designated SSC-P. This paper is concerned with the application of SSC-P to simulate loss-of-flow accident transients in a pool-type LMFBR. The models required for dynamic plant simulation are briefly highlighted. The system response is calculated for (1) a complete loss of electric power event, with scram, leading the plant into buoyancy-induced natural circulation, (2) a protected pipe rupture accident in the primary pump discharge line, and (3) an unprotected loss of off-site power event. For the last case, the predicted results from SSC-P are compared with the published results of Phenix behavior by NOVATOME.

61499 **(BNL-NUREG—31763) Approximate model for calculating overall heat transfer between overlying immiscible liquid layers with bubble-induced liquid entrainment.** Greene, G.A.; Schwarz, C.E. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 7p. (CONF-820717—2). NTIS, PC A02/MF A01.

From PAHR information exchange conference; Karlsruhe, F.R. Germany (28 Jul 1982).

In the event a commercial power reactor is subjected to a Class 9 accident resulting in gross core melting and reactor pressure vessel penetration, it has been shown that the containment integrity may subsequently be threatened by steam overpressurization, combustible gas reactions, and basemat penetration. A major contributor to these events would be the interaction of molten core debris with the structural concrete. Modeling of core-concrete interactions involves many poorly understood and complicated heat transfer phenomena for which there exists a sparse data base. One of these phenomena, which has been shown to have significant impact upon code calculations of core-concrete interactions, is the rate of heat transfer between overlying immiscible layers of core oxides and molten metals whose interface is agitated by transverse gas flow. A mathematical model is developed to analyze this heat transfer.

61500 **(EPRI-NP—2503) Homogeneous nonequilibrium critical flow model. Final report.** Levy, S.; Abdollahian, D. (Levy (S.), Inc., Campbell, CA (USA)). Jul 1982. 56p. NTIS, PC A04/MF A01. Order Number DE82906447.

A homogenous non-equilibrium flow model is developed to predict critical flow with subcooled upstream conditions. The model assumes an isentropic flow with a prescribed superheating for flashing. An iterative approach is used to solve for the critical flow and the predictions compare satisfactorily with available experimental data.

61501 **(EPRI-NP—2547) Full-scale controlled transient heat-transfer tests data-analysis report. Final report.** McIntyre, B.A.; Volpenhein, E.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). Aug 1982. 284p. NTIS, PC A13/MF A01. Order Number DE82906460.

Portions of document are illegible.

Transient critical heat flux (CHF) behavior has been studied under conditions typical of those calculated to occur in the first few seconds following a postulated large-break loss-of-coolant accident (LOCA) in a pressurized water reactor (PWR). A total of 25 tests were run in a 5 x 5 square rod array with a heated length of 12 feet (3.66 m). The rod design was typical of 15 x 15 type PWR fuel 0.422 in. (1.07 cm) in diameter. The axial power profile was a chopped cosine with a 1.66 peak to average power ratio. The primary focus of the testing was to obtain a data base, for transient CHF in a rod bundle cooled by water, that was amenable to model development efforts. A single controlled parameter variation approach was utilized for 21 of the 25 tests. The parameters varied included pressure, pressure decay rate, flow, flow decay rate, flow direction, power, inlet temperature, and initial system pressure. These parameters were selected to bound the values calculated to occur during a large-break PWR LOCA.

61502 **(GEND—015) Characterization of EPICOR II Prefilter Liner 16.** Yesso, J.D.; Pasupathi, V.; Lowry, L. (Battelle Columbus Labs., OH (USA)). Aug 1982. Contract AC07-76ID01570. 62p. NTIS, PC A02/MF A01. Order Number DE82022228.

Portions of document are illegible.

As part of the overall TMI-2 Information and Examination Program, EPICOR II Prefilter Liner 16 was examined to provide information to aid in the development of technology for safely processing highly loaded ion-exchange media. The characterization program included sampling and analyses of the liner contents, including ion-exchange media, liquids and gases, as well as examinations of the liner interior and exterior. This report details the handling of the liner, sampling and analysis of the contents, and the examinations of the liner.

61503 **(IAEA-TECDOC—248) Decontamination of operational nuclear power plants. Report of a technical committee meeting on the procedures for decontamination of operating nuclear power plants and handling of decontamination wastes organized by the IAEA and held in Mol, Belgium, 23-27 April 1979.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1981. 93p. (CONF-7904192—(Summ.)). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82702469.

From Technical committee meeting on the procedures of operating nuclear power plants and handling of decontamination wastes; Mol, Belgium (23 Apr 1979).

In order to reduce the radiation fields around nuclear power plants, and, consequently, to limit the radiation exposure of and dose commitments to the operating and maintenance personnel, the contamination build-up should be kept to a minimum. The most fruitful approach, from the point of view of economics and efficiency, is to tackle the problems of contamination and decontamination in the design and construction phases of the reactor. To do this, knowledge gained from the operation of existing power reactors should be used to make improvements in new designs. New structural materials with low corrosion rates or whose constituents are not activated by neutrons should also be used. For older reactors, in most cases it is already too late to incorporate design changes without extensive and expensive modifications. For these plants, decontamination remains the most efficient way to reduce radiation fields. The aim of this report is to deal with the different decontamination methods that may be applied to nuclear power plant circuits and equipment during operation. The factors that have to be considered in determining the type and the extent of the methods used are the engineering and the planning of the decontamination operation and the treatment of the resulting waste generated during the process are also discussed.

61504 (IAEA-TECDOC—248, pp 39-41) **Swedish programme for radioactivity control in BWR-reactors.** Persson, B. (Health Physics and Water Chemistry, Oskanshamnsverkets Kraftgrupp AB, Figeholm, Sweden). Jun 1981. NTIS (US Sales Only), PC A05/MF A01.

From Technical committee meeting on the procedures of operating nuclear power plants and handling of decontamination wastes; Mol, Belgium (23 Apr 1979).

The Swedish radiation protection authority has still put up a new goal for the total man-remdose for power-production that can be hard to obtain. That is 0.2 man-rem per installed MW electric in a year and that is a figure that we hadn't been able to obtain in our first BWR-reactor in Oskarshamm. As the goal is a mean-value for the whole Swedish programme we started to look especially on the design of our new reactors to see if they could be even better and thus give us the possibility to stay under that level. In this way the programme for activity control started up, and we soon found out that the new stations that had only partial condensate polishing could not be expected to give better results than the old ones. This fact started up the discussions of a system-deoontamination method and we decided to develop such a method on a joint Swedish base where also the manufacturer Asea-Atom participated. The research work for the decontamination method is being done at Studsvik but must in a later phase be done at the power-reactors in real systems. The work with modeling the activity building-up process is predominantly done by the utilities in cooperation with Asea-Atom and that includes also a lot of special samplings, analyses and measurements done at the stations. The strategy in using the decontamination method will depend on the results of the method itself but also on the prognose for past-decontamination operation that can come from the model.

61505 (IAEA-TECDOC—248, pp 43-59) **Decontamination of the primary loop of the BR3 nuclear power plant.** Gubel, P. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Jun 1981. NTIS (US Sales Only), PC A05/MF A01.

From Technical committee meeting on the procedures of operating nuclear power plants and handling of decontamination wastes; Mol, Belgium (23 Apr 1979).

The BR3 power station is a small PWR plant (net electrical output: 10.5MW) located at the site and owned by the Nuclear Research Centre "CEN-SCK" in Mol. A chemical decontamination of the primary loop of the plant was performed in October 1975 after the operation of core BR3/3B. This operation was aimed at the following goals: 1. To permit the easy access to the steam generator in view of its inspection. 2. To reduce the radiation fields around the primary piping and equipment, to facilitate the repair and inspection tasks during defuellings. The decontamination system used was a two-step process; the first one by the application of an oxydiser to facilitate the final solubility of some cations, the second one by the application of a complexing solution to solubilise the cations in the form of complexes.

61506 (IAEA-TECDOC—248, pp 61-70) **Decontamination of technological systems in German Democratic Republic nuclear power plants equipped with WWER-type reactors.** Herold, C.; Oertel, K.; Winkler, R. (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic)). Jun 1981. NTIS (US Sales Only), PC A05/MF A01.

From Technical committee meeting on the procedures of operating nuclear power plants and handling of decontamination wastes; Mol, Belgium (23 Apr 1979).

With a number of methodical variants of preparatory measures for such work, decontamination has gained considerable importance but its potential has not yet been comprehensively used in NPP practice. The latter applies particularly to such decontamination methods which cover the entire primary circuit and techno-

logically separable partial systems or non-dismountable large equipment. This is favoured by the fact that: the material expenditure for implementing such measures is of course high but evidently often overestimated; practical experience with the effects on materials is still small and also overshadowed by few negative examples; the requirements of decontaminating technological systems have been insufficiently considered so far in NPP projects. It is therefore the aim of this paper to discuss experience gained in decontaminating technological systems of NPP units in the GDR and the conclusions to be drawn.

61507 (IAEA-TECDOC—248, pp 71-75) **Experiences with decontamination methods at the nuclear power plant Muehleberg, Switzerland.** Aeppli, J. (Nuclear Safety Div., Wuerenlingen, Switzerland). Jun 1981. NTIS (US Sales Only), PC A05/MF A01.

From Technical committee meeting on the procedures of operating nuclear power plants and handling of decontamination wastes; Mol, Belgium (23 Apr 1979).

There are various methods available for the on-site decontamination of removable equipment in Switzerland: a shot peening glass beads method, using a mixture of demineralized water and glass beads within a closed box; high pressure water jet method; wet cleaning methods, using washing basins of different dimensions, detergent and brushes. The manuel cleaning is limited to a few cases, where the special form or the dimensions of the equipment do not allow the application of the glass bead method. Examples of the first two methods are discussed here. These methods have been in use at the nuclear power plant Muehleberg, which is a General Electric Mk I boiling water reactor of 306MWe (net) power and which has been in commercial operation since October 1972.

61508 (IAEA-TECDOC—248, pp 77-83) **Overview of the Canadian decontamination program.** Montford, B. (Ontario Hydro, Toronto (Canada)). Jun 1981. NTIS (US Sales Only), PC A05/MF A01.

From Technical committee meeting on the procedures of operating nuclear power plants and handling of decontamination wastes; Mol, Belgium (23 Apr 1979).

The main thrust of the Canadian program for the decontamination of power reactor systems and components started in 1970. It has been coordinated by the Decontamination Task Force which is comprised of members from the Public Utilities and AECL, the federal agency. The Task Force reports to the Activity Transport Working Party (ATWP). This latter group is also comprised of members from the Utilities and AECL. The objectives of the ATWP were to develop an understanding of radiation field growth around nuclear heat transport systems and use this understanding to make improvements in operating reactors and future reactors. The objectives of the Decontamination Task Force are: (1) to understand decontamination processes; (2) to develop decontamination procedures; (3) to feed back information to reactor designers. This document describes the experiences gained so far, the cost involved and the decontamination efficiency.

61509 (INIS-mf—6714, pp vp) **Numerical aspects of the RETRAN code system.** McFadden, J.H. (Energy Inc., Idaho Falls, ID (USA)); Agee, L.J. (Electric Power Research Inst., Palo Alto, CA (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The RETRAN-01 computer program is currently being utilized by approximately 45 organizations to perform SAR Chapter 15-type analyses and after-the-event analyses of operational incidents and accidents. The RETRAN-02 program is a major update to the original code and includes a one-dimensional neutronics model, a time dependent slip equation, vector momentum representation, balance of plant models, and an iterative solution method. Analyses performed with RETRAN-02 indicate significant improvement over RETRAN-01 analyses for small break LOCAs, ATWS transients, and some operational transients. This paper discusses the numerical aspects of (1) the steady-state solution method required for operational transient analyses, (2) the standard RETRAN solution method and the iterative solution technique, and (3) the solution methods for the one-dimensional kinetics model, the heat conduction equation, and the equation of state. Results of some analyses performed for the code verification and qualification phase of the development effort are summarized.

61510 (INIS-mf—6714, pp vp) **ONEDEE: A code to calculate the heat-up process during LOCA accidents in a PWR core.** Schor, L.; Albright, D. (Yankee Atomic Electric Co., Framingham, MA (USA). Nuclear Engineering and Development Dept.); Schor, A.L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A digital computer code, ONEDEE, has been developed to solve the equations describing the thermal energy transfer process that would occur if a nuclear fuel rod were subjected to a loss-of-coolant accident (LOCA) environment. ONEDEE solves the radial heat conduction equation for a single fuel rod and the one-dimensional conservation of energy equation for the associated fuel channel. Unconditionally stable numerical schemes have been selected for both equations. This, together with the implicit coupling at the fuel rod-coolant interface lead to complete flexibility in the choice of time steps. Indeed, the automatic time step control implemented in the code is based solely on accuracy requirements. Numerous numerical tests have proved the efficiency and reliability of the methods used. The code is intended to replace the RELAP4-HOT CHANNEL and TOODEE2 calculation in the Yankee WREM-based generic PWR ECCS Evaluation Model.

61511 (INIS-mf—6714, pp vp) **POSEIDON: A safety analysis computer system.** Kavenoky, A.; Lewi, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The POSEIDON system is a computer code developed to describe the transient thermal-hydraulic behaviour of a pressurised-water reactor in the case of postulated accidents (loss of coolant, pump failure...). The structure of this system is modular: management programs have been separated from calculation modules, in such a may that different physical models can be used sumultaneously for various components. In a circuit, the coupling of components is performed by a linking processor, called iterator, the principle of which is based on the transfer function method. An example of utilization is given at the end of this paper.

61512 (INIS-mf—6714, pp vp) **Mathematical and computational problems in LMFBR accident analysis.** Weber, D.P.; Kennedy, J.M.; Graff, D.L. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The development of the Liquid Metal Fast Breeder Reactor (LMFBR) offers an opportunity for effectively unlimited extension of uranium resources and for partially alleviating society's concern for abundant energy sources. In such a development, public health and safety may never be compromised and an examination of off normal events and their consequences is a necessity. Hypothetical core disruptive accidents (HCDA) have such a theoretical potential for endangering public safety and an assessment of these accidents and recommendations for their mitigation or elimination is an integral part of the development process. An accurate description of the complex thermal, hydraulic, mechanical and neutronic processes requires a combination of experimental programs to identify fundamental processes and large scale computer codes to integrate these effects into a system wide assessment. The mathematical description of these systems follows classic engineering analysis techniques but the complexity has increased due to effects including the treatment of strongly nonlinear systems and significant phenomenological and mathematical coupling between elements traditionally treated independently. Using the mathematical and computational

description as the conceptual link, we explore the similarities and differences in these analyses. Illustrations of some of the novel solution strategies currently being employed and indications of several problems still requiring additional consideration having key mathematical and safety implications for LMFBR accident analysis are provided.

61513 (INIS-mf—6714, pp vp) **Multi component drift flux formulation for the sinter subsystem of CONTAIN.** Senglaub, M.E.; Odom, J.P.; Pickard, P.S. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

CONTAIN is a systems analysis code designed to analyze post accident conditions in advanced or thermal reactors following the breach of the primary vessel. The CONTAIN code is divided into a number of major subsystems, one of which is the SINTER subsystem. The SINTER subsystem is used as a framework for describing the various physical phenomena which might occur in a reactor cavity debris pool. These physical processes include such phenomena as core and sodium concrete interactions, chemical reactions between various materials found in the debris pool, water migration in the concrete, phase transitions, sodium pool fires and heat and mass transport. Due to the complexity of the cavity debris pool, the framework developed for the SINTER subsystem is user oriented and very flexible in order to accommodate improved physical models. In this paper, the mathematical derivation used to provide the framework of the SINTER subsystem and the definitions and the approximations required will be presented. The mathematical formulation found to be best suited for the cavity debris problem is a variation of the drift flux formulations found in various other areas of reactor safety work.

61514 (INIS-mf—6714, pp vp) **Event sequences and consequence spectrum: A new approach to dynamic system safety.** Amendola, A. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Reina, G. (Studio MESA, Milan (Italy)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

This paper discusses the principal feature of the ESCS technique and ts implementation into the DYLAM computer code for dynamic system saftey analysis. Such technique permits, in principle, to identify all the physically possible incident sequences and their consequence spectrum, consistent with the assumptions performed for the system components. Each generated sequence is the result of dynamic and random interactions between the physics of the transient and the time evolving aspects of the component states. In this way, it is possible to overcome the drawbacks, which arise when separating the system fault analysis from the real dynamic incident development.

61515 (INIS-mf—6714, pp vp) **Application of software engineering to development of reactor safety codes.** Wilburn, N.P.; Niccoli, L.G. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Software Engineering, which is a systematic methodology by which a large scale software development project is partitioned into manageable pieces, has been applied to the development of LMFBR safety codes. The techniques have been applied extensively in the business and aerospace communities and have provided an answer to the drastically increasing cost of developing and maintaining software. The five phases of software engineering (Survey, Analysis, Design, Implementation, and Testing) were applied in turn to development of these codes, along with Walkthroughs (peer review) at each stage. The application of these techniques has resulted in SUPERIOR SOFTWARE which is well documented, thoroughly tested, easy to modify, easier to use and maintain. The development projects have resulted in lower overall cost.

61516 (INIS-mf—6822) **Survey of unusual incidents in the nuclear power plants of the Federal Republic of Germany in the year 1979.** (Bundesministerium des Innern, Bonn (Germany, F.R.)). 1980. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82780740.

The total number of reported incidents has slightly increased compared to the years 1977 and 1978; the number of the incidents relevant for safety engineering (category A), however, clearly decreased from 5 resp. 6 in 1977 resp. 1978. The rise of less important incidents having been reported is especially due to the reporting procedure having become more and more precise in cooperation with the central failure office founded by the GRS. The majority of the reported incidents did not concern failures of operation but faults resp. breakdowns which were found in redundant systems during the recurring tests carried out frequently in NPPs. This becomes manifest by the fact that nearly half the number of incidents had happened when the reactor was switched off or unloaded resp. that the incidents were discovered as possible disturbances. The greater part of the reported incidents had technical reasons, however, a smaller part was caused by human failures. Human failure was also a reason for the only incident of category A, the 30 minutes breakdown of energy supply in the GKN during the inspection phase.

61517 (INIS-mf—6845, pp vp) **Principles of fluid-structure interaction.** Schumann, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

Fluid-structure interaction (FSI) is an important physical phenomenon which has attracted significant attention in nuclear reactor safety analysis. Here, simple explanations of the principle effects of FSI are given and illustrated by reference to numerical and experimental results. First, a very simple fluid-structure model is introduced which consists of a spring supported piston closing a fluid filled rigid pipe. The motion of the piston and the fluid is approximately described by one degree of freedom, respectively. Depending on the load frequency and material parameters one finds that the coupled system is characterized by virtual masses and stiffnesses or by the inverse properties which are termed virtual fluidities and compressibilities. Thus the two parts interact as if they are connected in series or in parallel. The two eigenfrequencies of the coupled system enclose the eigenfrequencies of the individual fluid and structure parts. Second, the great importance of Hamilton's principle for derivation of the coupled equations of motion is emphasized. From this principle upper and lower bounds for the effective density of a heterogeneous fluid-solid mixture are deduced. Continuum models for such mixtures contain a virtual density tensor. Finally, we discuss FSI for the case of a loss-of-coolant accident (LOCA) in a pressurized water reactor (PWR) in the first (subcooled) blowdown period. Here, the fluid imposes pressure loadings on internal structures like the core barrel and the motion of these structures influences the fluid motion. Recent experimental results obtained at the HDR are compared with numerical predictions of the FLUX 2-code. The fair agreement confirms that we have well understood the principal effects of FSI.

61518 (INIS-mf—6845, pp vp) **Some fluid-structure interaction problems in pressurized water reactors.** Dienes, J.K. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

A sudden break in the hot or cold legs of a Pressurized Water Reactor can cause loading of the internal structure. The problem of determining the maximum stresses if complicated by the dynamic response of the internal structure, which is coupled to the wave motion of the fluid. We have found that the loadings can be quite different from the uncoupled loads, but no general statement about whether the stresses are raised or lowered by the coupling seems possible. Though the calculations are complicated, compari-

sons with experiment have shown surprisingly good agreement. We discuss briefly the American S^3 one twenty-fifth scale results, comparisons of calculations with the German HDR results, and some recent calculations concerning the motion of the guide tubes in the upper plenum of a PWR following a hot leg break.

61519 (INIS-mf—6845, pp vp) **Thermal-hydraulic models for use in simplified reactivity calculations under secondary break conditions.** Wagner, S.G.; Harris, K.P.; Mansur, J.M. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). 1981. NTIS (US Sales Only), PC A99/MF A01.

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

PWR accident analyses for breaks in the secondary system are characterized by extreme cooling of the core, large inlet temperature gradients, asymmetric stuck control rods and primary coolant flow predictions ranging from a few percent of nominal to full flow. For several years Combustion Engineering has been using the Hermite code to compute reacitvities, power distributions and flow distributions in 3-D for far off nominal thermal-hydraulic and neutronic conditions. These 3-D methods, while costly, have been very successful in analyzing a large class of PWR secondary break accidents. They indicate a much reduced post-scram return-to-power compared to less detailed, bounding core average feedback methods. The availability of a growing number of 3-D calculations has made it possible to develop and benchmark faster running of 2-D methods which account for many of the same effects seen in 3-D. Two such methods are described and evaluated in this paper and one method is shown to be realiable over a wide range of conditions.

61520 (LA-UR—82-1026) **Best-estimate analysis of a loss-of-coolant accident in a four-loop US PWR using TRAC-PD2.** Ireland, J.R. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 31p. (CONF-821101—2). NTIS, PC A03/MF A01. Order Number DE82014082.

From ASME winter annual meeting; Pheonix, AZ, USA (14 Nov 1982).

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A 200% double-ended cold-leg break loss-of-coolant accident (LOCA) in a typical US pressurized water reactor (PWR) was simulated using the Transient Reactor Analysis Code (TRAC-PD2). The reactor system modeled represented a typical US PWR with four loops and cold-leg emergency-core-cooling systems (ECCS). The calculated peak cladding temperature of 950 K occurred during blowdown and the cladding temperature excursion was terminated at 175 s when complete core quenching occurred. Accumulator flows were initiated at 10 s when the system pressure reached 4.08 MPa, and the refill phase ended at 36 s when the lower plenum refilled. During reflood, both bottom and falling film quench fronts were calculated. Top quenching was caused by entrainment from the lower plenum and lower core regions. The entrained liquid was sufficient to form a small, saturated pool (0.3 m deep) above the upper core support plate. Also, some of the entrained liquid was carried out the hot legs and vaporized in the steam generators. Strong multidimensional effects were calculated in the reactor vessel, particularly with respect to rod quenching.

61521 (LA-UR—82-2429) **TRAC analysis of the system pressure effects tests in the Slab Core Test Facility.** Smith, S.T. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 9p. (CONF-820802—19). NTIS, PC A02/MF A01. Order Number DE82021891.

From International meeting on thermal nuclear reactor safety; Chicago, IL, USA (29 Aug 1982).

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This paper describes the analysis, using the TRAC computer code, of three system pressure effects reflood tests performed during 1981 at the Slab Core Test Facility at the Japan Atomic Energy Research Institute in Tokai, Japan. Comparisons of the calculated results with the experimental data were very good, particularly for rod temperature histories, core differential pressures, mass inventories, liquid carryover, and fluid velocities in the loops. These comparisons indicate that the TRAC code can predict reasonably well the effects of pressure variations in test conditions. This and similar calculations demonstrate that TRAC is a useful tool for the design of nuclear reactor systems and the analysis of system response during postulated accident sequences.

61522 (LA-UR—82-2498) **Steam-generator-tube-rupture transients for pressurized-water reactors.** Dobranich, D.; Henninger, R.J.; DeMuth, N.S. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 13p. (CONF-820802—20). NTIS, PC A02/MF A01. Order Number DE82021762.

From International meeting on thermal nuclear reactor safety; Chicago, IL, USA (29 Aug 1982).

Steam generator tube ruptures with and without concurrent main-steam-line break are investigated for pressurized water reactors supplied by the major US vendors. The goal of these analyses is to provide thermodynamic and flow conditions for the determination of iodine transport to the environment and to provide an evaluation of the adequacy of the plant safety systems and operating procedures for controlling these transients. The automatic safety systems of the plant were found to be adequate for the mitigation of these transients. Emergency injection system flows equilibrated with the leakage flows and prevented core uncovery. Sufficient time was afforded by the plant safety systems for the operators to identify the problem and to take appropriate measures.

61523 (NUREG—0528-Suppl.3) **Safety Evaluation Report related to the operation of Wm. H. Zimmer Nuclear Power Station, Unit No. 1. Docket No. 50-358. Cincinnati Gas and Electric Company.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1982. 40p. GPO $4.75.

Information is presented concerning site characteristics; design criteria for structures, systems, and components; reactor; reactor coolant system and connected systems; engineered safety features; instrumentation and controls; electric power; auxiliary systems; conduct of operations; and TMI-2 requirements.

61524 (NUREG—0661-Suppl.1) **Safety Evaluation Report: Mark I containment long-term program. Resolution of Generic Technical Activity A-7.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1982. 20p. GPO $3.25.

When the NRC staff published Safety Evaluation Report, Mark I Containment Long-Term Program (NUREG-0661) in July 1980, four areas were identified where the technical issues had not been fully resolved. These were: (1) specification for condensation oscillation loads acting on the downcomers, (2) adequacy of the data base for specifying torus wall pressures during condensation oscillations, (3) possibility of asymmetric torus loading during condensation oscillations, and (4) effect of fluid compressibility in the vent system on pool swell loads. The first item, downcomer condensation oscillation loads, lacked an acceptable load definition. The remaining three items had acceptable specifications; however, NRC requested additional confirmatory information to justify the adequacy of the load specifications. This supplement addresses the resolution of the four issues listed above. In response to NRC concerns expressed in NUREG-0661, the Mark I Owners Group conducted additional experimental and analytical studies.

61525 (NUREG—0875) **Comments on the NRC Safety Research Program Budget for Fiscal Years 1984 and 1985.** (Nuclear Regulatory Commission, Washington, DC (USA). Advisory Committee on Reactor Safeguards). Jul 1982. 28p. GPO $3.75.

The comments are divided into three parts. Section 2 relates generally to programs for which greater effort or emphasis is needed. Section 3 provides specific comments on the proposed programs in each Decision Unit and, in most cases, for individual Subelements within each Decision Unit. Specific recommendations regarding the Research Program Support Budget are given in Section 4.

61526 **(NUREG—0881-Suppl.1) Safety Evaluation Report related to the operation of Wolf Creek Generating Station, Unit No. 1. Docket No. STN 50-482. Kansas Gas and Electric Company, et al.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1982. 30p. GPO $4.50.

Information is presented concerning site characteristics; design criteria for structures, systems, and components; engineered safety features; instrumentation and controls; conduct of operations; accident analysis; report of the Advisory Committee on Reactor Safeguards; and TMI-2 requirements.

61527 **(NUREG—0892-Suppl.1) Safety evaluation report related to the operation of WPPSS Nuclear Project No. 2. Docket No. 50-397, Washington Public Power Supply System.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1982. 242p. GPO $7.50.

Information is presented concerning site characteristics; design criteria for structures, systems, and components; engineered safety features; instrumentation and control; auxiliary systems; conduct of operations; and financial qualifications.

61528 (NUREG/CP—0031-Vol.2, pp 65-83) **Advanced techniques for real time simulation of reactor coolant system two-phase transients.** Luffey, F.C.; Meyer, P.E.; Murphy, J.H. Jun 1982. NTIS, PC A12/MF A01 - GPO $9.00.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

Current nuclear power plant training simulators have limited capability for the simulation of two-phase flow in the reactor coolant system following significant losses of primary coolant system (RCS). Increased attention to operation sequences or accidents leading to two-phase conditions in the RCS indicated a need to enhance this capability in plant simulators. This paper represents the major features of Westinghouse simulator technology by describing the hardware and software used in current Westinghouse-designed simulators, and the software under development for the advanced simulator. The advanced simulator is an all digital solution method and permits Westinghouse simulators to compute the two-phase fluid conditions in a reactor coolant system following significant losses of primary coolant, and other similar related transients. Simulator model requirements address both single- and two-phase flow, forced and natural circulation, phase separation, reliability, and real-time capability. The Westinghouse advanced simulator reactor coolant system model meets these requirements through non-equilibrium stratified fluid nodes, drift flux flow links, and global compressibility.

61529 (NUREG/CP—0031-Vol.2, pp 167-170) **Safety-related operator actions in nuclear power plants.** Haas, P.M.; Bott, T.F. (Oak Ridge National Lab., TN). Jun 1982. NTIS, PC A12/MF A01 - $9.00. Contract W-7405-ENG-26.

From CSNI specialist meeting on operator training and qualifications; Charlotte, NC, USA (12 Oct 1981).

The Safety Related Operator Actions Program at Oak Ridge National Laboratory is intended to provide the US Nuclear Regulatory Commission (USNRC) with quantitative and qualitative data on the performance of nuclear power plant operators during accident events. The data are necessary to support licensing decisions, standards development, and research in a number of areas related to operational safety. The program, which was developed after a preliminary assessment of available historic data, consists primarily of three tasks: (1) collection and assessment of data from controlled simulator exercises; (2) collection and assessment of field data; and (3) calibration of simulator to field data.

61530 **(NUREG/CP—0032) Workshop on meteorological aspects of emergency-response plans for nuclear power plants.** SethuRaman, S.; Tichler, J.; Patrinos, A.; Dabbert, W.F.; Ludwig, F.L.; Ruff, R.E. (comps.). (Brookhaven National Lab., Upton, NY (USA); SRI International, Menlo Park, CA (USA)). Aug 1982. Contract AC02-76CH00016. 143p. (BNL-NUREG—51552; CONF-811223—Summ.). NTIS, PC A07/MF A01 - GPO $6.50.

From Workshop on meteorological aspects of emergency response plans for nuclear power plants; Menlo Park, CA, USA (1 Dec 1981).

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The workshop was organized into five short introductory technical sessions, followed by working sessions. The technical sessions provided an overview of the state of the art in health physics; release characteristics; transport, diffusion, and deposition; and operational aspects. Three working groups of approximately 15 members each met for two days to develop specific recommendations and guidance for implementation of the regulatory requirements. The three working groups addressed the themes of health physics and meteorology, release characteristics and meteorology, and dispersion and deposition. This report summarizes the activities and results of both parts of the workshop. The main body of the report is organized in three chapters: an introduction; detailed recommendations of the three working groups; and a summary of the recommendations.

61531 **(NUREG/CR—2077) Uncertainty in soil-structure interaction analysis arising from differences in analytical techniques.** Maslenikov, O.R.; Chen, J.C.; Johnson, J.J. (Lawrence Livermore National Lab., CA (USA)). Jul 1982. Contract W-7405-ENG-48. 142p. (UCRL—53026). NTIS, PC A07/MF A01 - GPO.

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This study addresses uncertainties arising from variations in different modeling approaches to soil-structure interaction of massive structures at a nuclear power plant. To perform a comprehensive systems analysis, it is necessary to quantify, for each phase of the traditional analysis procedure, both the realistic seismic response and the uncertainties associated with them. In this study two linear soil-structure interaction techniques were used to analyze the Zion, Illinois nuclear power plant: a direct method using the FLUSH computer program and a substructure approach using the CLASSI family of computer programs. In-structure response from two earthquakes, one real and one synthetic, was compared. Structure configurations from relatively simple to complicated multi-structure cases were analyzed. The resulting variations help quantify uncertainty in structure response due to analysis procedures.

61532 **(NUREG/CR—2238-Vol.18) Advanced Reactor Research Program quarterly report, April-March 1981.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 252p. (SAND—81-1529-Vol.18). NTIS, PC A12/MF A01 - GPO.

Information is presented concerning inherent retention analysis for core debris behavior; containment analysis; elevated temperature design assessment; LMFBR accident delineation; advanced reactor core phenomenology; light water reactor damaged fuel phenomenology; and test and facility technology.

61533 **(NUREG/CR—2385) CSQ calculations of H_2 detonations in the Zion and Sequoyah nuclear plants.** Byers, R.K. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1982. Contract AC04-76DP00789. 52p. (SAND—81-2216). NTIS, PC A04/MF A01 - GPO.

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This report presents results from eleven calculations concerning the detonation of a dry hydrogen:air mixture in various models of nuclear reactor containment structures. One calculation treats a large, dry containment (Zion); the remaining analyses consider separate portions of an ice condenser containment (Sequoyah). The calculations were carried out with a well-tested, two-dimensional continuum mechanics code, using a simplified model that forces detonation to occur. All problem boundaries were treated as rigid - that is, no attempt was made to characterize the response of the structures to the loads imposed on them.

61534 **(NUREG/CR—2513) Advisability of an automatic seismic scram.** O'Connell, W.J.; Wells, J.E. (Lawrence Livermore National Lab., CA (USA)). Dec 1981. Contract W-7405-ENG-48. 64p. (UCRL—53037). NTIS, PC A04/MF A01 - GPO.

The advisability is examined of requiring commercial nuclear power plants to have a seismic scram system set at a high trip level

- e.g., 0.6 SSE. A high trip level is intended to ameliorate one disadvantage, namely, loss of electric generation after an earthquake when a trip is not necessary for reactor protection. There are also advantages to a seismic scram. A seismic trip will give a lead time before other trip initiators. A few seconds is a significant time - 3 s required to scram, and 5 to 10 s for 50% reduction of stored heat in the fuel rods. Then transient pressure and loads will be reduced. Using a decision tree, the risks involved in both employing and not employing a seismic scram system are compared. For a hypothetical site a seismic scram system significantly reduces the probability that an earthquake will cause a core melt, but it increases the probability that after the earthquake electric generation for community services and for operating the nuclear power plant's safety systems will be lost.

61535 **(NUREG/CR—2591) Estimating the potential impacts of a nuclear reactor accident: methodology and case studies. Final research report Mar 81-Mar 82.** Cartwright, J.V.; Beemiller, R.M.; Trott, E.A. Jr; Younger, J.M. (Bureau of Economic Analysis, Washington, DC (USA). Regional Economic Measurement Div.). Apr 1982. 136p. NTIS, PC A07/MF A01.

This NUREG describes an industrial impact model that can be used to estimate the regional industry-specific impacts of disasters, both natural and manmade. Special attention is given to the impacts of possible nuclear reactor accidents. The report also presents three applications of the model. The impacts estimated in the case studies are based on (1) general information and reactor-specific data, supplied by the U.S. Nuclear Regulatory Commission (NRC); (2) regional economic models derived from the Regional Input-Output Modeling System (RIMS II) developed at the Bureau of Economic Analysis (BEA); and (3) additional methodology developed especially for taking into account the unique characteristics of a nuclear reactor accident with respect to regional industrial activity.

61536 **(NUREG/CR—2593) User's manual for computer code RIBD/IRT. Final report.** Thayer, D.D.; Lurie, N.A. (Sandia National Labs., Albuquerque, NM (USA); IRT Corp., San Diego, CA (USA)). Jan 1982. Contract AC04-76DP00789. 65p. (SAND—82-7013). NTIS, PC A04/MF A01 - GPO.

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The computer code RIBD/IRT is a modified version of RIBD-II. It is a grid processor that calculates isotopic concentrations resulting from two fission sources with normal down-chain decay by beta emission and isomeric transfers and inter-chain coupling resulting from n-gamma reactions. Calculations can be made to follow an irradiation history through an unlimited number of step changes of unrestricted duration and variability including shutdown periods, restarts at different power levels and/or any other level changes. Output information includes time-dependent inventories, activities, decay powers, and energy releases for as many as 800 fission products. Modifications to RIBD-II were necessitated by Loss-of-Coolant Accident (LOCA) studies conducted by IRT Corporation regarding fission product source term definition. This manual describes the modifications to RIBD-II, input requirements and a sample problem. The appendices give a listing of RIBD/IRT, sample output, and a listing of a code called ZIP which prepares the library tape for input to RIBD/IRT.

61537 **(NUREG/CR—2594) User's manual for the GABAS spectrum computer code. Final report.** Thayer, D.D.; Lurie, N.A. (Sandia National Labs., Albuquerque, NM (USA); IRT Corp., San Diego, CA (USA)). Jan 1982. Contract AC04-76DP00789. 44p. (SAND—82-7014). NTIS, PC A03/MF A01 - GPO.

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The Gamma and Beta Spectrum computer code (GABAS) was developed at IRT Corporation for calculating time-dependent beta and/or gamma spectra from decaying fission products. GABAS calculates composite fission product spectra based on the technique used by England, et al., in conjunction with the CINDER family of fission product codes. Multigroup beta and gamma spectra for individual nuclides are folded with their corresponding time-dependent activities (usually generated by a fission product inventory code) to produce a composite time-dependent fission product spectrum. This manual contains the methodology employed by GABAS, input requirements for proper execution, a sample problem and a FORTRAN listing compatible with a UNIVAC machine. The code is available in a UNIVAC 1100/81 version and a VAX 11/780 version. The former may be obtained from the Radiation Shielding Information Center (RSIC); the latter may be obtained directly from IRT Corporation.

61538 **(NUREG/CR—2646) Model for boiling and dryout in particle beds.** Lipinski, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1982. Contract AC04-76DP00789. 177p. (SAND—82-0765). NTIS, PC A09/MF A01 - GPO.

Over the last ten years experiments and modeling of dryout in particle beds have produced over fifty papers. Considering only volume-heated beds, over 250 dryout measurements have been made, and are listed in this work. In addition, fifteen models to predict dryout have been produced and are discussed. A model is developed in this report for one-dimensional boiling and dryout in a porous medium. It is based on conservation laws for mass, momentum, and energy. The initial coupled differential equations are reduced to a single first-order differential equation with an algebraic equation for the upper boundary condition. The model includes the effects of both laminar and turbulent flow, two-phase friction, and capillary force. The boundary condition at the bed bottom includes the possibility of inflowing liquid and either an adiabatic or a bottom-cooled support structure. The top of the bed may be either channeled or subcooled. In the first case the channel length and the saturation at the base of the channels are predicted. In the latter case, a criterion for penetration of the subcooled zone by channels is obtained.

61539 **(NUREG/CR—2673) Evaluation of thermal devices for detecting in-vessel coolant levels in PWRs.** Hardy, J.E.; Davis, C.E.; Turnage, K.G.; Anderson, R.L. (Oak Ridge National Lab., TN (USA)). Aug 1982. Contract W-7405-ENG-26. 70p. (ORNL/TM—8306). NTIS, PC A04/MF A01 - GPO.

From investigations conducted immediately after the Three Mile Island nuclear power plant accident, some safety areas needing improvement were identified. One new US NRC requirement was the unambiguous detection of the approach to adequate core cooling. Designs to meet this requirement have generally included new instrumentation to monitor the coolant level in the reactor vessel. Thermal sensors proposed for use in pressurized-water reactor (PWR) vessels were tested and evaluated. The thermal devices tested use pairs of K-type thermocouples or resistance temperature detectors to sense the cooling capacity of the medium surrounding the device. One sensor of the pair is heated by an electric current, while the unheated one senses the ambient fluid temperature. The temperature difference between the heated and unheated sensors provides an indication of the cooling capacity of the surrounding fluid. Experiments that simulated the thermal-hydraulic conditions of a postulated PWR loss-of-coolant accident (LOCA) were run, including both natural- and forced-convection two-phase flow tests. Results suggest that thermal level devices generally indicate the existence of poor cooling conditions in LOCA environments. In some cases, however, the indication of the thermal devices may not be a direct measurement of water level. Shielding and separator tubes have been devised to ensure that the thermal sensors indicate the collapsed liquid level inside the separator tube. Preliminary evaluation of these protection systems is given.

61540 **(NUREG/CR—2753) Analysis of a double-ended cold-leg break simulation: THTF Test 3.05.5B.** Craddick, W.G.; Pevey, R.E. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 107p. (ORNL—5886). NTIS, PC A06/MF A01 - GPO.

On July 3, 1980, an experiment was performed in the Oak Ridge National Laboratory Thermal-Hydraulic Test Facility that simulated a double-ended cold-leg break pressurized-water reactor (PWR) accident. Analysis of the experiment revealed that nuclear fuel rods exposed to the same hydrodynamic environment as that which existed in the experiment would have departed from nucleate boiling both earlier and later than the fuel rod simulator (FRS), de-

pending on the size of the gap between the nuclear fuel pellets and cladding and on the initial power of the nuclear fuel rod. Comparison of the results of the current experiment, which used an FRS bundle with geometry similar to 17 x 17 PWR fuel assemblies, to the results of earlier experiments, which used an FRS bundle with geometry similar to 15 x 15 PWR fuel assemblies, revealed no differences that can be attributed to the difference in geometries.

61541 **(NUREG/CR—2758) Parametric study of containment emergency sump performance.** Weigand, G.G.; Krein, M.S.; Wester, M.J.; Padmanabhan, M. (Sandia National Labs., Albuquerque, NM (USA); Worcester Polytechnic Inst., Holden, MA (USA). Alden Research Lab.). Jul 1982. 210p. (SAND—82-0624; ARL—46-82). GPO $7.00.

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A systematically structured test program designed to characterize the hydraulic behavior of full-scale emergency core cooling system (ECCS) sumps under a broad range of geometric configurations and flow conditions has been conducted. The effects of potential accident induced perturbations on sump performance were also evaluated. These perturbations included screen blockage, nonuniform approach flows, break flow and ice condenser drain flow impingement, and obstructions. In addition, the effects of elevated water temperature and the performance of vortex suppression devices have been established. The results show that the vortices are unstable and that vortex size and type is not a reliable indicator to adjudge air ingestion or swirl behavior.

61542 **(NUREG/CR—2763) Loss-of-coolant accident (LOCA) simulation tests on polymers: the importance of including oxygen.** Gillen, K.T.; Clough, R.L.; Ganouna-Cohen, G.; Chenion, J.; Delmas, G. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1982. Contract AC04-76DP00789. 40p. (SAND—82-1071). NTIS, PC A03/MF A01 - GPO.

Experiments were performed to survey the effects on material degradation of both aging conditions and the oxygen concentration during a LOCA simulation. Changes for a number of commercial materials commonly used as electric cable jackets and insulations in nuclear power plant applications were monitored in terms of weight, mechanical properties, solubility measurements and infrared spectroscopy. For a number of these materials (an EPR insulation, a chloroprene jacket and a PVC jacket), the concentration of oxygen during LOCA simulation was found to be an important parameter. For the first two materials, more degradation occurred when oxygen was present; for PVC, substantially increased swelling occurred as the oxygen concentration was lowered. Aging conditions were also found to have a very substantial influence. In particular, for a number of the materials, lowering the radiation dose rate used for aging led to enhanced degradation after both the aging and the LOCA simulation. The different materials examined showed very different behaviors in terms of the degradation resulting from aging and from LOCA simulation.

61543 **(NUREG/CR—2776) Alarms within advanced display systems: alternatives and performance measures.** Danchak, M.M. (Hartford Graduate Center, CT (USA)). Sep 1982. Contract AC07-76ID01570. 54p. (EGG—2202). NTIS, PC A04/MF A01 - GPO.

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This study surveys five advanced alarm handling systems in industries having problems similar to nuclear process control. The survey identifies the uniqueness of each system as well as features common to all. One such common feature is the use of alphanumeric alarm message strings displayed on cathode ray tubes (CRT). The study presents alternatives for display of this information and dynamic techniques for the addition and deletion of alarms. A software package is described that incorporates the alternatives and allows low-fidelity experiments to be conducted in an environment that simulates nuclear process control. The package was used to test static aspects of alarm CRTs and led to the conclusion that quantitative data should come before qualitative data in alarm message strings. Methods for low-fidelity testing of display dynamics are also discussed.

61544 **(NUREG/CR—2784) Behavior of water spray injected into air/steam environment.** Lee, S.Y.; Tankin, R.S. (Northwestern Univ., Evanston, IL (USA). Dept. of Mechanical and Nuclear Engineering). Aug 1982. 150p. GPO $6.50.

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The behavior of a water spray injected into both an air and a steam environment was studied. The water spray was divided into two parts - sheet portion and droplet portion. An analytical model is proposed for explaining the spray behavior. Experiments were performed to substantiate the analytical results. Holographic pictures were used to obtain the droplet size distribution. These size distributions were used for computing the motion of spray droplets in the analytical model. For the sprays used in this study, the sheet portion plays a very important role in the heat transfer phenomenon. The spray angle is primarily governed by the sheet portion. In addition, the axial extent (length) of sheet is a very important parameter in determining the spray angle. A correlation is obtained experimentally for breakup length in terms of the Weber number and the Jakob number.

61545 **(NUREG/CR—2814-Vol.1) Nuclear reactor safety. Progress report, January 1-March 31, 1982.** Stevenson, M.G. (comp.). (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 39p. (LA—9442-PR-Vol.1). NTIS, PC A03/MF A01.

The work that is highlighted here represents accomplishments for the period January 1-March 31, 1982 by the groups at Los Alamos involved in reactor safety research for the Division of Accident Evaluation, Office of Nuclear Regulatory Research of the US Nuclear Regulatory Commission. Presented are brief overviews compiled by project, along with a bibliography of Technical Notes and publications written during this quarter. Information is presented concerning the TRAC code development; thermal-hydraulic analysis for PWR after ECCS operation; failure criteria for graphites used in HTGR type reactors; upper structure dynamics experiments; CRBR loss-of-flow accident analysis; and LWR severe accident analysis.

61546 **(PB—82-204322) The availability and reliability of complex systems: some analytical methods.** Jokela, S. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoetekniikan Lab.). Apr 1976. 109p. NTIS, PC A06/MF A01.

This report deals with analytical methods to calculate the unavailability, failure density, and unreliability of good, complex systems, e.g. of engineered safety systems. The methods are based on the minimal cut sets and the use of the stationary properties of systems with repair or test. An example is given, with detailed calculations, to demonstrate the ability of the methods to cope with complexity.

61547 **(PB—82-204678) Common mode failures.** Mankamo, T. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoetekniikan Lab.). May 1976. 71p. NTIS, PC A04/MF A01.

This study was initiated in order to get a state of the art review of the common mode failure concept, and of the methods developed for analyzing dependent failures. Applications to nuclear power plants are considered.

61548 **(PB—82-206830) Common load model: a tool for common cause failure analysis.** Mankamo, T. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoetekniikan Lab.). Dec 1977. 41p. NTIS, PC A03/MF A01.

A model is developed to assess the dependency of failures when redundant structures are loaded by a common stress. Both the common stress and the resistance of the structural items are assumed to be distributed normally or log-normally. The study results in a simple power law: the multiple failure probability can be expressed in terms of the single failure probability. The wider application of this power law in the analysis of common cause failures is discussed.

61549 **(SAND—82-0383C) Insights from the Interim Reliability Evaluation Program pertinent to reactor-safety issues.** Carlson, D.D. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 7p. (CONF-820802—21). NTIS, PC A02/MF A01. Order Number DE82021870.

From International meeting on thermal nuclear reactor safety; Chicago, IL, USA (29 Aug 1982).

The Interim Reliability Evaluation Program (IREP) consisted of concurrent probabilistic analyses of four operating nuclear power plants. This paper presents an integrated view of the results of the analyses drawing insights pertinent to reactor safety. The importance to risk of accident sequences initiated by transients and small loss-of-coolant accidents was confirmed. Support systems were found to contribute significantly to the sets of dominant accident sequences, either due to single failures which could disable one or more mitigating systems or due to their initiating plant transients. Human errors in response to accidents also were important risk contributors. Consideration of operator recovery actions influences accident sequence frequency estimates, the list of accident sequences dominating core melt, and the set of dominant risk contributors. Accidents involving station blackout, reactor coolant pump seal leaks and ruptures, and loss-of-coolant accidents requiring manual initiation of coolant injection were found to be risk significant.

61550 **(SAND—82-0441C) Steam explosions of a metallic melt as its degree of oxidation increases: Fe, $FeO_{1.0}$, and $FeO_{1.2}$.** Nelson, L.S.; Duda, P.M. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 8p. (CONF-820802—17). NTIS, PC A02/MF A01. Order Number DE82022005.

From International meeting on thermal nuclear reactor safety; Chicago, IL, USA (29 Aug 1982).

Laboratory-scale steam explosions have been initiated reproducibly by exploding a submerged bridgewire shortly after single drops of melt are released into liquid water. By using drops of molten Fe, $FeO_{1.0}$ and $FeO_{1.2}$, the effects of melt oxidation level on the explosions are investigated. It is shown that bubbles of H_2 rapidly surround the drops of the two less oxidic melts as a result of the redox reaction as they enter the water; measurement of these bubbles provides good estimates of the oxidation rates of the melts in steam; and it becomes more difficult to trigger the explosions as the oxidation level decreases because of the cushioning effect of the hydrogen bubbles that envelop the drops. This study, coupled with field scale expriments and analytical modelling, provides insight into possible steam explosion hazards associated with partially oxidized corium melts which might form in a light water reactor loss-of-coolant incident.

61551 **(SAND—82-0450C) Break flow and two-phase jet-load model.** Weigand, G.G.; Thompson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 10p. (CONF-820802—16). NTIS, PC A02/MF A01. Order Number DE82022004.

From International meeting on thermal nuclear reactor safety; Chicago, IL, USA (29 Aug 1982).

Portions of document are illegible.

A model has been developed for predicting two-phase, water jet loads. The model ranges in application from 60 to 170 bars pressure and 70°C subcooled liquid to 0.75 (or greater) quality - completely covering the range of vessel conditions of interest in pressurized water or boiling water reactors. The model was developed using advanced two-dimensional computational techniques to solve the governing equations of mass, momentum, and energy. The model predicts subcooled loadings in excess of the twice (stagnation pressure) x (exit area), one-dimensional limit, thus questioning the conservatism of current jet load models. Simple, approximate engineering models are given for estimating expansion characteristics, shock strengths, and stagnation pressures. These approximate models could be used for estimating pressures on various geometric target configurations.

61552 **(SAND—82-1260C) Hydrodynamic model of hydrogen-flame propagation in reactor vessels.** Baer, M.R.; Ratzel, A.C. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 18p. (CONF-821026—3). NTIS, PC A02/MF A01. Order Number DE82021724.

From 2. international workshop on the impact of hydrogen on water reactor safety; Albuquerque, NM, USA (3 Oct 1982).

A hydrodynamic model for hydrogen flame propagation in reactor geometries is presented. This model is consistent with the theory of slow combustion in which the gasdynamic field equations are treated in the limit of small Mach numbers. To the lowest order, pressure is spatially uniform. The flame is treated as a density and entropy discontinuity which propagates at prescribed burning velocities, corresponding to laminar or turbulent flames. Radiation cooling of the burned combustion gases and possible preheating of the unburned gases during propagation of the flame is included using a molecular gas-band thermal radiation model. Application of this model has been developed for 1-D variable area flame propagation. Multidimensional effects induced by hydrodynamics and buoyancy are introduced as a correction to the burn velocity (which reflects a modification of planar flame surface to a distorted surface) using experimentally measured pressure-rise time data for hydrogen/air deflagrations in cylindrical vessels.

61553 **(SAND—82-1812C) Cost-benefit considerations for filtered-vented containment systems.** Benjamin, A.S.; Strip, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 23p. (CONF-820833—9). NTIS, PC A02/MF A01. Order Number DE82020290.

From 17. DOE nuclear air cleaning conference; Denver, CO, USA (1 Aug 1982).

Portions of document are illegible.

As part of Sandia's severe accident research program for the U.S. Nuclear Regulatory Commission, we have been investigating the cost-benefit tradeoffs of filtered-vented containment (FVC) systems for a variety of reactory types. To quantify these evaluations, we have been assessing the reduction in accident risks that is achievable from a variety of containment venting concepts and the costs associated with retrofitting these concepts into existing reactors. We have been appraising our results in terms of the Commission's proposed safety goals and in terms of the true costs of reactor accidents. Our preliminary results indicate that FVC systems are not cost effective for most of the pressurized water reactors that we have evaluated. On the other hand, they appear to be potentially cost effective for the boiling water reactors. The promising results for BWRs, however, are predicted on a simple, inexpensive containment venting design that uses only the existing suppression pool as a scrubber. 2 figures, 6 tables.

61554 **(SAND—82-1923C) Debris-bed model to predict the effect of gas influx from below on the dryout heat flux.** Gorham-Bergeron, E. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 11p. (CONF-820802—7). NTIS, PC A02/MF A01. Order Number DE82020441.

From International meeting on thermal nuclear reactor safety; Chicago, IL, USA (29 Aug 1982).

Portions of document are illegible.

A model has been developed to predict the effect of gas influx from below on the coolability of a debris bed. Numerical solution of the mass, energy and momentum conservation equations show that significant reductions in the dryout heat flux only occur close to an easily calculated cut-off inlet gas velocity. This velocity is strongly dependent on the density of the incoming important factor in reducing the dryout power of the bed. Comparison of model predictions with the results of particle-bed flooding experiments show reasonable agreement. From these comparisons insight into deficiencies of the the model is gained.

61555 **(UFRJ-COPPE-PEN—103) Reliability analysis of Angra I safety systems.** de Oliveira, L.F.S.; Soto, J.B.; Maciel, C.C.; Gibelli, S.M.O.; Fleming, P.V.; Arrieta, L.A. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). Jul 1980. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702669.

An extensive reliability analysis of some safety systems of Angra I, are presented. The fault tree technique, which has been successfully used in most reliability studies of nuclear safety systems performed to date is employed. Results of a quantitative determination of the unvailability of the accumulator and the containment spray injection systems are presented. These results are also compared to those reported in WASH-1400.

61556 **(WSL-LR—355(AP)) Wind tunnel model experiments on a buoyant emission from a building.** Hall, D.J.; Barrett, C.F.; Simmonds, A.C. (Warren Spring Lab., Stevenage (UK)). May 1980. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702468.

The report describes wind tunnel model experiments of a preliminary nature on a leak of buoyant gas from the face of a building, the intention being to reproduce some facets of one kind of catastrophic reactor failure. The measurements covered heat release rates of 1 to 100 MW over a windspeed range of 1 to 10 ms^{-1}. Measurements were made of ground level concentrations of the released gas downwind of the building, together with a limited number of vertical concentration measurements. Results of the experiments showed that ground level concentrations were mainly determined by plume buoyancy; the point of emission on the building, or even the presence of the building having only a secondary effect.

61557 **Multiphase, multicomponent hydrodynamics in HCDA analysis. Present status and future trends.** Bell, C.R. (Los Alamos National Lab., NM (USA)). *Nuclear Engineering and Design;* **68**: No. 2, 91-99(Mar 1982).

From International seminar on internal loading and containment of fast breeder reactors (CONFABRE-3); Ispra, Italy (24 - 25 Aug 1981).

The scope and complexity of hypothetical core meltdown accident phenomenology is outlined. Approaches for assessing the recritically characteristics and the tendencies for severe, containment challenging events is addressed also. Some results of initial analyses with SIMMER-II, which attempts to include the numerous multicomponent, multiphase effects on material movements and reactor neutronic response, are described. Perspectives are offered regarding the role of the internal structures in the termination of neutronic activity during a core meltdown accident sequence.

61558 **Theory and application of a finite element method for Arbitrary Lagrangian-Eulerian fluids and structures.** Kennedy, J.M. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.); Belytschko, T.B. (Northwestern Univ., Evanston, IL (USA). Technological Inst.). *Nuclear Engineering and Design;* **68**: No. 2, 129-146(Mar 1982).

From International seminar on internal loading and containment of fast breeder reactors (CONFABRE-3); Ispra, Italy (24 - 25 Aug 1981).

A coupled model for the analysis of three-dimensional structures interacting with a three-dimensional axisymmetric fluid has been developed. The model is intended for the study of the role of above core structures in core disruptive accidents. Because the fluid model must be capable of interacting with the structure while it experiences large deformations, an Arbitrary Lagrangian-Eulerian (ALE) mesh description, which enables the motion of the nodes to be programmed by the user, was chosen. Both the structural and the fluid model are programmed in a finite element format for the sake of versatility. Example calculations for a two-dimensional bubble problem, which served primarily to verify the computational algorithm for the fluid are presented. For the purpose of examining the capability of the method and simulating the response of above core structures in a CDA, numerous simulations were made of some SRI scale model tests. The results show reasonable agreement with the experiment.

61559 **Three-dimensional method for integrated transient analysis of reactor-piping systems.** Wang, C.Y. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* **68**: No. 2, 175-184(Mar 1982).

From International seminar on internal loading and containment of fast breeder reactors (CONFABRE-3); Ispra, Italy (24 - 25 Aug 1981).

A three-dimensional method for integrated hydrodynamic, structural, and thermal analyses of reactor-piping systems is presented. The hydrodynamics are analyzed in a reference frame fixed to the piping and are treated with a two-dimensional Eulerian finite-difference technique. The structural responses are calculated with a three-dimensional co-rotational finite-element methodology. Interaction between fluid and structure is accounted for by iteratively enforcing the interface boundary conditions. A thermal transient capability has been developed. A system energy equation is used to compute the coolant temperatures due to convection. A radial heat-conduction equation is employed to establish the temperature profile throughout the pipe-wall thickness. The constitutive equation used for the thermal-mechanical stress calculation is suited for a large number of materials under various loading conditions, such as those having thermal, plastic, and viscous effects. The flow surface, which defined the purely elastic regime, can be arbitrarily small; an associated flow rule is utilized for regimes of material plasticity. Three sample problems are presented to illustrate this method. The first one calculates the piping response under the seismic excitation. The second one validates the heat-conduction model. The third problem deals with a coupled hydrodynamic-structural-thermal analysis of a piping system. Results are discussed in detail.

61560 **Some remaining problems in HCDA analysis.** Chang, Y.W. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* **68**: No. 2, 185-194(Mar 1982).

From International seminar on internal loading and containment of fast breeder reactors (CONFABRE-3); Ispra, Italy (24 - 25 Aug 1981).

Structural mechanics in fast reactor technology appears to have made significant progress. The computational methods and computer codes developed for HCDA analysis can predict reasonably well the response of the primary containment boundary system. The level of attainment at this time has been sufficient to provide the necessary input to design and safety evaluation of LMFBR plants. What remains is the extension of this technology to reduce the conservatism in HCDA analysis and to provide more realistic models to reduce the cost of future LMFBR plants.

61561 **Accommodation of potential hydrogen formation in LMFBR accidents.** Stepnewski, D.D.; Peak, R.D.; Mahaffey, M.K. (Hanford Engineering Development Lab., Richland, WA (USA)); Absher, K.R. (Department of Energy, Richland, WA (USA). Richland Operations Office). *Nuclear Engineering and Design;* **68**: No. 2, 213-224(Mar 1982).

From International seminar on internal loading and containment of fast breeder reactors (CONFABRE-3); Ispra, Italy (24 - 25 Aug 1981).

Results of design verification tests for the FFTF reactor cavity liner system are presented which suggest that steel liners would retain their integrity even under certain hypothetical accident conditions, thus, avoiding the formation of hydrogen. When liner failures are postulated in hypothetical reactor vessel melt-trough accidents, hydrogen levels can be controlled by an air purging system. The design of a containment purging and effluent scrubbing system is discussed.

61562 **PKL tests on energy transfer mechanisms during small-break LOCAs.** Mandl, R.M.; Weiss, P.A. (PKL project, Hammerbacherstr, Federal Republic of Germany). *Nuclear Safety;* **23**: No. 2, 146-158(Mar 1982).

The Primarkreislaufe (PKL) test facility, originally designed to examine the refill and reflood phases of a loss-of-coolant accident, was modified and used for a series of transient and steady-state small-break tests. Results from these tests are presented with the intention of showing the influence of such parameters as power,

reduce water inventories on the primary or secondary sides, and noncondensible gas on the ability of the system to remove decay heat. It is shown that in the case of a small break, the transport of decay heat from the system is ensured when a two-phase coolant mixture covers the core and energy can be removed from the secondary sides of the steam generators.

61563 **Development of appropriate methods for processing post-accident contaminated water.** Collins, E.D.; King, L.J.; Knauer, J.B. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **38**: 498-499(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61564 **Design features to maximize simplicity, operability, and inherent safety of LMFBRs.** Amorosi, A.; Sackett, J.I.; Singer, R.M. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **38**: 615-616(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61565 **The probability distribution of the unavailability of a system.** Dickey, J.M.; Hall, R.E.; Smith, J.M. (BNL, Upton, NY 11973). *Transactions of the American Nuclear Society;* **38**: 631-632(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61566 **An analytic model of freezing penetration in tube flow.** Hayden, N.K. (Sandia, Albuquerque, NM 87185). *Transactions of the American Nuclear Society;* **39**: 671-672(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61567 **Evaluation of the defence in depth concept in the light of the Three Mile Island accident.** Fuchs, H.; Gibbs, K.P. (Motor-Columbus Ingenieurunternehmung A.G., Baden (Switzerland)). pp 3-12 of Current nuclear power plant safety issues. Proceedings of an international conference organized by the IAEA and held in Stockholm, Sweden, 20-24 October 1980. Vienna, Austria; International Atomic Energy Agency (1981).

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

One of the fundamental bases of reactor safety has been the 'defence in depth' concept. Valuable lessons for plants outside the USA can be learned by studying both the strengths and weaknesses of all the various lines of defence in the light of the TMI findings. These lessons can be summarized as follows: Quality: lack of quality led to the initiation of the event through frequent trips, one of which eventually led to the sticking open of the PORV. It also led to wrong diagnosis of the fault. Multiple failures during the many hours the incident lasted distracted the operator and made a careful diagnosis of its causes and progress impossible. Reactor protection system: the Babcock and Wilcox PWR, with its once-through steam generators (OTSG), responds more rapidly than other LWRs to some operating transients. This does not necessarily result in a less safe system provided that the reactor protection system is designed with the fast response in mind, e.g. by providing anticipatory trips. This emphasizes the importance of a systems approach to design rather than too much reliance on codes and standards, which may not recognize important plant differences. Safety systems: For similar reasons the low water content of the OTSG could have been compensated for by a higher reliability in the emergency feed system. In US practice the operator plays an important role in aligning safety systems, whereas in Europe there is more extensive automation. The latter system leads to an analysis of a wider spectrum of faults to ensure that the automatics respond correctly in all circumstances. Containment: The TMI incident showed that the containment can be very valuable for situations where far more core damage and hydrogen production occurs than is predicted for design basis accidents. Continuing containment integrity depends on core cooling and on the correct operation or isolation of many other systems, whose role in such accidents has not always been recognized.

61568 **Qualification testing evaluation program for safety-related equipment.** Bonzon, L.L.; Gillen, K.T.; Clough, R.L.; Salazar, E.A.; Buckalew, W.H.; Thome, F.V.; Stuetzer, O.M. (Sandia National Labs., Albuquerque, NM (USA)); Feit, R. (Nuclear Regulatory Commission, Washington, DC (USA)). pp 13-26 of Current nuclear power plant safety issues. Proceedings of an international conference organized by the IAEA and held in Stockholm, Sweden, 20-24 October 1980. Vienna, Austria; International Atomic Energy Agency (1981).

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

The nuclear power industry is required to demonstrate that certain safety-related equipment is "qualified" and will function even in the event of a severe reactor accident. Demonstration of qualification by testing is the preferred approach. International interest in equipment qualification, and its recognition as being paramount to safety, are rapidly increasing, with most major supplier-countries developing sophisticated qualification testing facilities. Qualification testing of safety-related equipment must be demonstrated to be both realistic and conservative. Thus a program of qualification methodology assessment and improvement is imperative. In the USA, the Nuclear Regulatory Commission (NRC) is sponsoring the Qualification Testing Evaluation Program with the goal of obtaining data that will confirm or improve the technical bases for equipment qualification programs. While this multi-task program has long-term, continuing objectives, recent results are being used to modify NRC regulations with attendant impact on the nuclear industry. This paper presents selected examples of results from the QTE Program to illustrate the broad scope of the research.

61569 **Automatic diagnosis of alarms. A system to improve operator emergency response.** Olson, H.P.; Gimmy, K.L.; Nomm, E.; Finley, R.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). pp 501-510 of Current nuclear power plant safety issues. Proceedings of an international conference organized by the IAEA and held in Stockholm, Sweden, 20-24 October 1980. Vienna, Austria; International Atomic Energy Agency (1981).

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

A system is being developed at the Savannah River Plant to help reactor operators respond to multiple alarms in a developing incident situation. The need for such systems has become evident in recent years, particularly after the Three Mile Island incident.

61570 **Decay heat removal systems. Design criteria and options.** Berry, D.L. (Sandia National Labs., Albuquerque, NM (USA)). pp 213-231 of Current nuclear power plant safety issues. Proceedings of an international conference organized by the IAEA and held in Stockholm, Sweden, 20-24 October 1980. Vienna, Austria; International Atomic Energy Agency (1981).

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

Design criteria and alternative decay heat removal system concepts which have evolved in several different countries throughout the world were compared. The conclusion was reached that the best way to improve the reliability of pressurized-water reactor (PWR) decay heat removal is first to focus on improving the reliability of the auxiliary feedwater and high-pressure injection systems to cope with certain loss-of-feedwater transients and small loss-of-coolant accidents and then to assess how well these systems can handle special emergencies (e.g., sabotage, earthquake, airplane crash). For boiling-water reactors (BWRs), it was concluded that emphasis should be placed first on improving the reliability of the residual-heat removal and high-pressure service water systems to cope with a loss of suppression-pool cooling following a loss of feedwater transient and then to assess how well these systems can handle special emergencies. It was found that, for both PWRs and BWRs, a design objective for alternate decay heat removal systems

should be at least an order of magnitude reduction in core meltdown probability. To reach this reliability objective, a group of design criteria was developed to assure independence of alternative systems. A second group of criteria for handling extreme special emergencies was also developed. Because a small fraction of core meltdowns in some power plants can represent a major portion of the total public risk, it was found that existing decay heat removal systems which are adequately reliable from the standpoint of preventing core meltdown may need to be assessed also from the standpoint of public risk. This should be done before a final decision is made regarding the benefits to a particular power plant of installing an alternative system.

61571 **Filtered-vented containment systems.** Benjamin, A.S.; Walling, H.C. (Sandia National Labs., Albuquerque, NM (USA)); Cybulskis, P. (Battelle Columbus Labs., OH (USA)); DiSalvo, R. (Nuclear Regulatory Commission, Washington, DC (USA)). pp 233-255 of Current nuclear power plant safety issues. Proceedings of an international conference organized by the IAEA and held in Stockholm, Sweden, 20-24 October 1980. Vienna, Austria; International Atomic Energy Agency (1981).

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

During the past year and a half, the potential benefits of filtered-venting containment systems as a means for mitigating the effects of severe accidents have been investigated. The studies so far have focused upon two operating reactor plants in the USA, a large-containment pressurized-water reactor and a Mark I containment boiling-water reactor. A number of design options have been formulated that could be retrofitted to these plants, including single-component once-through venting systems, multiple-component systems with vent and recirculation capabilities, and totally contained venting systems. A variety of venting strategies have also been considered, including both simple low-volume containment pressure relief strategies and more complicated, high-volume venting strategies that require anticipatory actions. The latter type of strategy is intended for accidents that produce containment-threatening pressure spikes. It was found that relatively simple filtered-vented containment systems have the potential for reducing the consequences of some acci accidents significantly. For the PWR, a single-component system could provide enough fission product retention to eliminate early fatalities and reduce latent cancer fatalities tenfold, compared to the consequences resulting from an overpressurization rupture of containment. It was estimated that a state-of-the-art system with that capability would cost about 16 million US dollars per reactor, but it was also concluded that it might be possible to develop less costly systems with comparable capabilities. The as-yet unanswered questions are whether or not a complicated venting strategy is necessary in order to circumvent pressure spikes, and whether or not the competing risks would render such a strategy undesirable. These questions are now being dealt with by conducting experiments and by performing a comprehensive probabilistic risk assessment.

61572 **Senior nuclear safety overview committee functions in the preoperational phase.** Baird, Q.L.; Bouchey, G.D.; Twitty, B.L. (WPPSS, Richland, WA 99352). *Transactions of the American Nuclear Society;* **39**: 848-850(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61573 **Application of an inverse heat conduction solution procedure.** Weber, C.F. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **39**: 496-497(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61574 **A practical prescription for solving the multiphase fluid dynamics equations.** *Transactions of the American Nuclear Society;* **39**: 502-503(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61575 **Modified ICE technique for two-phase systems with strong mass sources.** Cahalan, J.E.; Graff, D.L. (ANL, Argonne, Il 60439). *Transactions of the American Nuclear Society;* **39**: 504-505(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61576 **TRAC-PD2 and RELAPS/MOD1 predictions of heated rod bundle experiments.** Neymotin, L. (BNL, Upton, NY 11973). *Transactions of the American Nuclear Society;* **39**: 1018-1019(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61577 **Some new aspects of core degradation during a PWR small break LOCA.** Bowers, C.H.; Chung, H.M.; Stuart, R.; Thomas, G.R. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **39**: 364-365(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61578 **Downward penetration of a hot liquid pool into an underlying meltable solid.** Farhadieh, R.; Bingle, J.D.; Epstein, M. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **35**: 363-364(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61579 **Phenomenological investigation of fast reactor fuels response under LOF and prompt-burst heating conditions.** Cano, G.L. (Sandia Natl Labs, Albuquerque, NM 87115). *Transactions of the American Nuclear Society;* **35**: 354-355(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61580 **Application of differential sensitivity theory to transients with scram.** Parks, C.V.; Maudlin, P.J.; Weber, C.F. (UCC-ND, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **35**: 376-378(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61581 **A one-dimensional transient model for analyzing large-scale steam explosion experiments.** Corrandini, M.L. (Sandia Natl Labs, Albuquerque, NM 87115). *Transactions of the American Nuclear Society;* **35**: 298-300(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61582 **TRAC-PIA predictions of the Battelle-Frankfurt top blowdown test.** Neymotin, L. (BNL, Upton, NY 11973). *Transactions of the American Nuclear Society;* **35**: 330-332(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61583 **TRAC-PD2 analysis of ORNL Thermal-Hydraulic test facility test 177.** Gilbert, J.S.; Mandell, D.A.; Mullins, C.B. (LASL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **35**: 332-334(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61584 **Response of LOFT SPNDs to reactor coolant density variations during a LOCA simulation.** Adams, J.P.; Berta, V.T. (EG&G Idaho, Idaho Falls, ID 83415). *Transactions of the American Nuclear Society;* **35**: 334-336(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61585 **A particle-bed dryout model with upward and downward boiling.** Lipinski, R.J. (Sandia Natl Labs, Albuquerque, NM 87115). *Transactions of the American Nuclear Society;* **35**: 358-360(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 61109, 61672

2505 Flywheels

61586 **(NASA-CR—163465) A study pertaining to inertial energy storage machine designs for space applications. Final report.** Zowarka, R.C. (Jet Propulsion Lab., Pasadena, CA (USA)). Aug 1981. 68p. NTIS, PC A04/MF A01.

The preliminary design of a counterrotating fast discharge homopolar generator (HPG) and a counterrotating active rotary flux compressor (CARFC) for space application is reported. The HPG is a counterrotating spool-type homopolar with superconducting field coil excitation. It delivers a 20-ms, 145-kJ pulse to a magnetoplasmahydrodynamic thruster. The peak output current is 42.7 kA at 240 V. After 20 ms the current is 29.7 kA at 167 V. The CARFC delivers ten 50-kJ, 250 microsecond pulses at 50-ms interval to six Xenon flash lamps pumping an Nd glass laser. The flux compressor is counterrotating for torque compensation. Current is started in the machine with a 5-kV, 5-kJ pulse-charged capacitor. Both designs were based upon demonstrated technology. The sensitivity of the designs to technology that may be available in five to ten years was determined.

2506 Thermal

REFER ALSO TO CITATION(S) 61154, 61157, 61245

61587 **(CONF-820827—11) New physical-chemical reactions useful for TES.** Johnson, J.S. Jr.; Westmoreland, C.G. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE82020807.

From Energy storage contractors review meeting; Arlington, VA, USA (23 Aug 1982).

New options in materials for heat storage is the aim of the program. Chemical systems, including those having equilibria with high temperature coefficients, are tested by differential scanning calorimetry for evidence of enhanced heat capacity. The approach is high-risk and exploratory; and in the search for new classes of storage systems, relatively little weight is given the costs of members of the classes that are at present apparent. Several possibilities have been tested in a preliminary way. These include concentrated aqueous solutions of a hydrolyzable metal ion; aqueous solutions of polyethylene oxide-polypropylene oxide polymers, which when cross-linked take up or eject water in temperature cycles; and soluble partially fluorinated organic compounds, in hope that hydrates might be formed and be melted in temperature ranges of interest (analogous to clathrates). Certain petroleum ester waxes have also been tested. No promising embodiments have been found so far, but the survey is too incomplete as yet to rule any out.

61588 **(DOE/RL/10120—1) Thermal-convective instabilities in saturated aquifers. Final report.** Booker, J.R. (Washington Univ., Seattle (USA)). Sep 1981. Contract AT06-79RL10120. 41p. NTIS, PC A03/MF A01. Order Number DE82020316.

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An acoustic emission detection scheme is employed to investigate the behavior of microfracture production in sandstone as hot brine is passed over one surface of the sample. A possible explanation is given for the resulting count rate as a function of time. A course for future study is outlined.

2508 Chemical

REFER ALSO TO CITATION(S) 61075, 61862

2509 Batteries

REFER ALSO TO CITATION(S) 61746, 61798

61589 **(ANL/OEPM—81-14) Research, development, and demonstration of nickel-iron batteries for electric-vehicle propulsion. Annual report for 1981.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Mar 1982. Contract W-31-109-ENG-38. 128p. NTIS, PC A07/MF A01. Order Number DE82021216.

Portions of document are illegible.

The FY '81 program continued to involve full-size, prototype cell, module and battery fabrication and evaluation, aimed at advancing the technical capabilities of the nickel-iron battery, while simultaneously reducing its potential cost in materials and process areas. Improved Electroprecipitation Process (EPP) nickel electrodes of design thickness (2.5 mm) are now being prepared that display stable capacities for the C/3 drain rate with less than 10% capacity decline for greater than 1000 test cycles. Iron electrodes of the composite-type are delivering 24 Ah at the target thickness (1.0 mm). Iron electrodes also are displaying capacity stability for greater than 1000 test cycles in continuing 3-plate cell tests. Finished cells have delivered 57 to 63 Wh/kg at C/3, and have demonstrated cyclic stability up to 1200 cycles at 80 percent depth of discharge profiles. Modules evaluated at the National Battery Test Laboratory (NBTL), Argonne National Laboratory, have exceeded 580 test cycles and remain on test. Reduction in nickel electrode swelling (and concurrent stack starvation), to improve cycling, continues to be an area of major effort to reach the final battery cycle life objectives. Pasted nickel electrodes continue to show promise for meeting the life objectives while, simultaneously, providing a low manufacturing cost. Two full-size pasted nickel electrode cells have exceeded 700 cycles at C/3 rates to 80 to 100 % depth of discharge. Refinements have occurred in the areas of cell hardware, module manifolding and cell interconnections as a result of a related DOE/JPL battery demonstration program. These improvements have been incorporated into the construction and testing of the cells and modules for this ANL/DOE program.

61590 **(ANL/OEPM—82-3) Annual synopsis of Argonne's aqueous battery support research, fiscal year 1981.** Cook, G.M. (comp.). (Argonne National Lab., IL (USA)). Mar 1982. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01. Order Number DE82021143.

This report describes the major activities of the Battery Support Group research staff for fiscal year 1981. The present activities are ultimately directed at improving the performance of lead-acid, nickel/zinc and nickel/iron batteries, especially those for electric vehicle or utility load-leveling applications. In addition to short descriptions of each of the projects, summaries of work accepted for publication, published or presented during the year are included.

61591 **(DOE/ET/25106—T1-Vol.3) Sodium-sulfur battery development Phase III report, 1 August 1977-31 December 1978.** (Ford Aerospace and Communications Corp., Newport Beach, CA (USA). Aeronutronic Div.). 1 Feb 1979. Contract AC02-76ET25106. 340p. NTIS, PC A15/MF A01. Order Number DE82019395.

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About 250 cells were built and evaluated in electrical tests at Aeronutronic during the period from September 1977 to December 1978. The basic design was common for all cells which used electrolyte tubes with a 34-mm (1.34-in.) diameter and a 250-mm (9.84-in.) length. The diameter of the metallic containers also was essentially constant. Consequently, the rated capacity was nearly the same for all cells. They differed mainly in the construction of the sulfur electrode, the safety tube, or the protective coatings on the sulfur container. Electrical performance of these cells depended mainly on the nature of the sulfur electrodes and the resistance of the sulfur containers. The usable capacity ranged from 35 to 100%

of that available if all of the cell's sulfur was converted to Na_2S_3 (the rated capacity). The efficiency, i.e., the percentage of the stored energy which could be reused, ranged from 60 to 85. Results are reported in detail. (WHK)

61592 **(EPRI-EM—2579) Development of advanced batteries for utility application. Final report.** Bast, J. (General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.). Sep 1982. 250p. NTIS, PC A11/MF A01. Order Number DE82906459.

Portions of document are illegible.

The interim results of a program to develop Beta (sodium-sulfur) Batteries for utility load-leveling applications are presented. The reporting period is June 1979 through June 1981. The accomplishments of the Laboratoires de Marcoussis of the Compagnie d'Electricite, France, while under subcontract to General Electric Company, are an important part of this program and are included. During this period, a cell design was established that is predicted to be cost-effective in the battery configuration for utility application. The cell electrolyte is a General Electric Generation VIII beta"-alumina ceramic, which has demonstrated excellent performance in cell tests conducted over the last six months of this period. A major technical decision was made to change from beta-alumina to beta"-alumina in the electrolyte. As a result of this decision, considerable work was performed on development of the ceramic composition and on process development of the internal seal (the seal that attaches the electrolyte to the alpha-alumina header). A composition of GE Generation VIII beta"-alumina was selected. Tests of Generation VIII beta"-alumina show no asymmetric polarization, relatively low aging rates, no corrosion on the sulfur side, and substantially less blackening than other GE beta"-alumina tubes. Scale-up of all cell components and processes for the utility cell design are either complete or progress is proceeding satisfactorily. Electrolyte scale-up is proceeding successfully. Chromized steel container materials with duplex coating consistently showed excellent performance. Considerable effort was applied to posttest examination of electrolytes to determine major degradation modes. Testing of beta-alumina cells, which achieved a maximum life of 2.25 Ah/cm^2 with a cell capacity of 52% at end of life, was discontinued in favor of cells with beta"-alumina, which have achieved life of 752 Ah/cm^2.

61593 **(LBL—14304) Applied battery and electrochemical research program report for 1981.** McLarnon, F. (Lawrence Berkeley Lab., CA (USA)). 1 Jun 1982. Contract AC03-76SF00098. 158p. NTIS, PC A08/MF A01. Order Number DE82020600.

Lawrence Berkeley Laboratory (LBL) is a lead laboratory for management of the Applied Battery and Electrochemical Research Program, which provides supporting research for the Department of Energy (DOE) Electrochemical Systems research programs. The general objective of this program is to help provide advanced electrochemical systems that can satisfy stringent performance and economic requirements for electric vehicle and stationary energy storage applications. The specific goal of the program is to identify the most promising electrochemical technologies and transfer them to industry and/or another DOE program for further development and scale-up. General problem areas addressed by the program include identification of new electrochemical couples for advanced batteries, determination of technical feasibility of new couples, improvements in battery components, and establishment of engineering principles applicable to batteries and electrochemical processes. Major emphasis is given to applied research that will lead to superior performance and lower life-cycle costs. The program is divided into four major areas: Exploratory Battery R and D, Engineering-Science Research, Materials Research, and Electrolytic Processes. Progress is reported.

61594 **(LBL—14305) Technology-base research project for electrochemical energy storage report for 1981.** McLarnon, F. (ed.). (Lawrence Berkeley Lab., CA (USA)). Jun 1982. Contract AC03-76SF00098. 95p. NTIS, PC A05/MF A01. Order Number DE82020599.

The Technology Base Research (TBR) Project provides the applied research base that supports all Department of Energy (DOE) electrochemical energy storage applications: electric vehicles, electric load-leveling, storage of solar electricity, and energy and resource conservation. The goal of the TBR project is to identify electrochemical technologies having the greatest potential to satisfy stringent performance and economic requirements and transfer them to industry or another DOE project for further development and scale-up. The TBR project consists of four major elements: electrochemical systems research, supporting research, electrochemical processes, and fuel cells for transportation. A summary of activities in these four project elements during 1981 is presented. Information is included on: Iron-air batteries; aluminum-air batteries; Lithium-metal sulfide cells; materials development for various batteries, and the characteristics of an NH_3-Air alkaline fuel cell in a vehicle.

61595 **(LBL—14674) Development of a high-rate insoluble zinc electrode for alkaline batteries.** Charkey, A. (Lawrence Berkeley Lab., CA (USA); Energy Research Corp., Danbury, CT (USA)). Apr 1982. Contract AC03-76SF00098. 33p. NTIS, PC A03/MF A01. Order Number DE82020608.

Activated ZnO samples were formulated which singly, or in combination with dilute electrolyte formulations, result in partially insoluble discharge products. Activated ZnO, prepared by alloy vaporization or by thermally accelerated diffusion of metallic dopants into the ZnO lattice, which had proved to be less soluble than pure ZnO, also proved to be less electrochemically active. This resulted, generally, in reduced efficiency, higher degrees of polarization and passivation and decreased conductivity. These properties are known to be detrimental to the performance of secondary Ni-Zn batteries and this approach was abandoned. For this reason a new approach to electrode material formulation was adopted. Active material was mixed dry with materials which would provide an insoluble matrix after initial reaction in the cell electrolyte. These electrodes are expected to exhibit improved performance in two ways. Firstly, there is an even distribution of permanent, highly conductive nucleation sites along the apparent electrode surface, providing for even Zn deposition and distribution during charging. Secondly, the increase in effective surface area decreases actual current densities, thereby, decreasing overvoltages. This should decrease dendrite formation and gas evolution in addition to allowing for the use of higher apparent current densities. Problems posed by the development of this type of electrode material are, for the most part, material selection problems. Materials must be chosen carefully, not just to fulfill their given function within the electrode system, but also to provide for minimal counter-productive interaction with each other. Electrochemical evaluations of these types of materials show generally favorable behavior.

61596 **(LBL—14815) Two-dimensional triangular lattice and its application to lithium-intercalated layered compounds.** de Cerqueira, R.O. (Lawrence Berkeley Lab., CA (USA)). Aug 1982. Contract AC03-76SF00098. 105p. NTIS, PC A06/MF A01. Order Number DE82021788.

Thesis. Portions of document are illegible.

Good rechargeable batteries are being searched for use in electric vehicles and in energy storage during off-peak consumption periods and from solar sources. The interest in lithium intercalation compounds has been recently enhanced by the search for such batteries. The process of intercalation of lithium in several transition-metal dichalcogenides can provide an emf of several volts. The progress achieved in the last decade in the investigation of these intercalates has been facilitated by the availability of the dichalcogenides as single crystals and by their chemical stability. The transition-metal dichalcogenides and their Li-intercalates are studied, with emphasis on the Li/sub x/Ta/sub y/Ti/sub 1-y/S_2 series. The interactions between the Li atoms and the applicability of a lattice gas model to the problem of ordering of these atoms is discussed. A formulation is presented of the cluster-variation approximation to the lattice gas problem. The single-site and the nearest-neighbor triangle basic clusters are considered as models for Li/sub x/TiS_2. Also a theory is presented for the effects of a random distribution of different species of host atoms, as in Ta/sub y/Ti/sub 1-y/S_2. (WHK)

61597 **(PB—82-202490) Lead-acid battery manufacture - background information for promulgated standards. Draft report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Nov 1980. 59p. NTIS, PC A04/MF A01.

Standards of performance for the control of emissions from lead-acid battery manufacturing plants are being promulgated under the authority of Section 111 of the Clean Air Act. These standards would apply to new, modified, or reconstructed facilities at any lead-acid battery manufacturing plant with the capacity to produce in one day batteries which would contain in total an amount of lead greater than or equal to 5.9 Mg (6.5 tons). This document contains information on public comments made after proposal, EPA responses and differences between the proposed and promulgated standards.

61598 **(SAND—82-7050) Comparison of prices for conventional and advanced storage batteries for residential, commercial, and utility applications.** Ramsay, G.B.; Edgecomb, A. (Gould, Inc., Rolling Meadows, IL (USA). Federal Systems Lab.). Aug 1982. Contract AC04-76DP00789. 77p. NTIS, PC A05/MF A01. Order Number DE82022151.

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This study evaluated the technical and economic performance of ten battery technologies for use in residential, commercial, and utility size load leveling systems. The batteries chosen for detailed economic analysis were: the low-maintenance lead-acid battery; the maintenance-free lead-acid battery; the nickel-cadmium battery; the zinc-bromine battery; and the lithium-metal sulfide battery. Details of the costing methodology are presented. The results of this comparative life-cycle cost analysis indicate the future potential of the Zn-Br technology for all three system sizes and the near-term attractiveness of the maintenance-free lead-acid technology for the residential and commercial applications.

61599 **(UCRL—15479) Aluminum-air battery cell hardware development. Period covered 1 January 1982-30 April 1982.** (Lawrence Livermore National Lab., CA (USA); Lockheed Palo Alto Research Labs., CA (USA)). 30 Apr 1982. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01. Order Number DE82020175.

Air cathodes were evaluated to determine polarization characteristics and the effect of aluminate, stannate and carbonate concentration. Tests confirmed prior measurements by Electromedia Corporation (EMC) that polarization is about 30 mV/kAm^{-2} at the electrode surface. Air cathodes from another vendor exhibited comparable performance. Variation in electrolyte composition caused on only small changes (<10%) in cathode performance. The rapidly-refuelable, subscale Mark 1-2 Aluminum-Air battery (moving cathode) was evaluated. Peak power density was measured at 2.7 and 3.1 kW/m^2 which is similar to performance of the Mark 1-1 cell. Fabrication of the rapidly-refuelable, 6-cell module with 200-cm^2 moving anodes was partially completed.

29 ENERGY PLANNING AND POLICY

61600 **(AFMD—81-40) Millions wasted trying to develop major energy information system.** (Comptroller General of the United States, Washington, DC (USA)). May 1981. 81p. NTIS, PC A05/MF A01.

A Federal energy information system created to improve Federal and State energy regulation by providing computerized access to current energy data is reviewed. It is concluded that the system failed because management deficiencies existed in planning, development, and implementation. Moreover, the cost and progress of the system was not monitored. Poor communication among system developers and intended users at the Federal and State levels, lack of continuous involvement and support from top Federal management, and disruptions in both organization and personnel are also cited as reasons for the system's failure.

61601 **Productivity measures for energy management.** Turner, W.C.; Tompkins, B.W. (Oklahoma State Univ., Stillwater). *American Institute of Industrial Engineers, Detroit Chapter, Proceedings of the Annual Conference;* 59-66(1981). (CONF-810538—). Detroit, MI, USA (17 May 1981).

An examination is made of energy productivity monitoring and control measurement systems. The indices of Btu unit of production, Btu/square foot of conditioned space, and Btu/direct labor hour are all examined. Then some rather unique or new ideas are presented and discussed. Suggestions are made for designing effective energy productivity measurement systems. Next, energy cost accounting is discussed; cost center metering, and it's cost effectiveness are presented. Suggestions are made for evolving toward effective energy metering. Particular emphasis is given to what utility should be metered and where the metering should occur. Concluding the paper are various companies' experiences with monitoring and measuring the productivity of energy resources.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 61709

61602 **(ANL/CNSV—30) Disaggregating input-output models.** Wolsky, A.M. (Argonne National Lab., IL (USA)). Feb 1982. Contract W-31-109-ENG-38. 31p. NTIS, PC A03/MF A01. Order Number DE82021268.

A general solution is given to the problem: with little computation, construct a more disaggregated input-output model from an available model, using information about some activities that were aggregated when the available model was built. The solution is exact and explicit. Concomitant approximate solutions, with error bounds, are also given. When only partial information is available, the exact solution guides its user to inexpensive and precise sensitivity analysis. Detailed consideration is accorded to the solution of the most frequently occurring problem - the disaggregation of one sector into two.

61603 **(CONF-810842—7) Energy-data validation: an overview and some concepts.** Loebl, A.S.; Cantor, S. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01. Order Number DE82020901.

From American Statistical Association meeting; Detroit, MI, USA (10 Aug 1981).

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Energy data validation can be viewed operationally as a three-fold assessment process: (1) a determination of the quality of the data collected, i.e., an assessment of accuracy; (2) an analysis of the relevance and usefulness of the data so as to assess how closely the data collected is meeting the requirements of its users; (3) an assessment of measures that can be taken to enhance the effectiveness of the data system under study. Assessment (1) is akin to the process of critical evaluation of data in the physical sciences. Assessments (2) and (3), the more distinctive features, underlie two important goals of validation. In brief, the analyst validates both the information and the requirements for the information, and as deficiencies in these two aspects are uncovered, the validation analyst formulates and evaluates the means for correcting these deficiencies. This paper focuses upon the use of an error model for systematizing the assessment of accuracy in a data-system validation study. Other topics discussed briefly are: a capsule history of energy-data validation; ORNL studies of outlier detection methods, automatic data editing and sampling theory in support of the energy-data validation program; reviews of energy-data requirements.

61604 **(EUR—6756-FR) Implementation of EEC models for Belgium: energy-demand models.** Cherif, M.; Guillaume, Y.; Rouland, O. (Brussels Univ. (Belgium). Dept. d'Economie Appliquee). 1980. 52p. (In French). European Community Information Service, 2100 M Street NW, Washington, DC 20037.

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A description is given of macroeconomic models, sectional input-output and energy demand models. Also discussed is the philosophy of the central variant, including study techniques, model modifications, improvements. Also presented are various scenarios predicted by various models with respect to petroleum prices, energy demand, the effect of higher TVA rates on energy consumption, and modifications of export structure. 3 references, 13 tables.

61605 **(EUR—6762-FR-Vol.4) Development of an optimization model of an energy system. The analysis and modelling of energy systems program. Nuclear moratory, Level II phase 1.** Finon, D. (Institut Economique et Juridique de l'Energie, Grenoble (France)). 1980. 60p. (In French). European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037.

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Tabular results are given of the MOSE model with respect to nuclear electricity importance in the primary energy total, energy balance in the MTOE, secondary energy sources, aggregated balance of energy sources, energy source consumption by industrial, domestic and district users, coal subsystems, nuclear fuels, and energy-producing equipment construction. 13 tables.

61606 **(EUR—6762-FR-Vol.5) Development of an optimization model of an energy system. The analysis and modelling of energy system program. Level II-phase 1. Results of MOSE model. Nuclear costs.** Finon, D. (Institut Economique et Juridique de l'Energie, Grenoble (France)). 1980. 59p. (In French). European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037.

Portions of document are illegible.

Tabular results are given of the MOSE model with respect to primary energy balance that involves gas imports, local coal, hydrogen, space heating, waste heat recovery, gasification, solar, geothermal energy resources, gas by-products, hydrogen balance, capacities of energy-producing equipment, solar cells, and windmills. 13 tables.

61607 **(EUR—7779-EN) Energy economy of the Netherlands as part of the European Community's linear energy model.** Droste, F.P.M. (Technische Hogeschool Twente, Enschede (Netherlands)). 1982. 121p. European Community Information Service, 2100 M Street NW, Washington, DC 20037.

This report describes the Dutch version of the EFOM-12C energy model. Development and utilization of this model to assist in policy analysis and technology assessment, is part of the European Community's energy research program. A case study based on the model is presented in the second part of this report. (PSB)

61608 **(JACKFAU—81-252-2) Development of hybrid I-O tables compatible with the energy-disaggregated input-output (EDIO) model. Final report.** (Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA)). Jan 1981. Contract AC01-79EI10513. 82p. NTIS, PC A05/MF A01. Order Number DE82021283.

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This report provides the documentation for a project whose primary objective was to incorporate energy consumption Btu data by input-output (I-O) sectors from the National Energy Accounts (NEA) into the 1973 Energy Disaggregated Input-Output (EDIO) Model, thereby creating a Hybrid EDIO for 1973. In addition, two supplemental tasks were undertaken. The first was to compare the techniques used for the valuation of energy products in the Bureau of Economic Analysis (BEA) and NEA I-O systems. The second was to devise a methodology that could be used to project the Hybrid EDIO Table for 1973 to 1985 and 1990. The report is divided into three parts which reflect the above three tasks as follows: Insertion of Btus Flow Data into the EDIO Table for 1973; Evaluation of Value Data for Energy Products in the NEA and BEA I-O Tables; and Methodology for the Creation of the Hybrid EDIO Tables for 1985 and 1990.

61609 **Long-term macroeconomic equilibrium model for the European community.** Rogner, H.H. Laxenburg, Austria; International Institute for Applied Systems Analysis (1982). 88p. (IIASA-RR—82-13).

This report presents a version of MACRO calibrated for the European Community (EC), focusing on model structure, model validation and testing, and four applications to the EC region over a fifty-year planning period. The applications, based on a range of energy supply scenarios, examine such economic questions as the impact of rising energy costs on economic activity, the feasibility of common assumptions about price-induced conservation, and the impact of continued high levels of energy imports on the trade balance. In essence, MACRO describes supply-constrained economic activity, using energy as the constrained input factor. The model is built around a constant elasticity of substitution (CES) production function, which represents substitution processes among capital, labor, and energy. MACRO differs from similar models of energy-economy interactions through its use of explicit factor functions and an empirically based procedure for estimating the CES production function's parameters. To overcome the problem of long-term extrapolations of econometric functions, which were estimated using data from a relatively short sample period, the model concentrates on slowly changing variables, including the capital: output ratio, investment and consumption rates, population, and the labor force. The model also contains exogenously determined scenario parameters, which can be used to countervail short-term trends inherent in the estimated parameters, as well as to simulate policy measures.

61610 **Mathematical modelling of energy systems.** Kavrakoglu, I. (ed.). Alphen aan den Rijn, Netherlands; Sijthoff and Noordhoff (1981). 486p. (CONF-7906244—). Martinus Nijhoff Publishers BV, 2501 CN - The Hague, The Netherlands, $55.00.

From NATO Advanced Study Institute conference on mathematical modelling of energy systems; Istanbul, Turkey (9 Jun 1979).

Topics covered include: modelling energy-economy relations; national energy systems; electricity systems modelling; methodology in modelling; cooperation in model implementation; and crude oil pricing mechanism. (GHT)

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 60838, 60840, 61053, 61054, 61145, 61187, 61609, 61621, 61636, 61644, 61660, 61662, 61726, 62048, 62049

61611 (CONF-8110215—, pp 27-30) **Land use planning: a league perspective.** Reeves, M.B. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

Policy changes for putting less reliance of solar and renewable energy sources as well as a decreasing emphasis on energy conservation is opposed by public opinion according to this League of Women Voter's speaker. She also discusses the League's position on the Clean Air Act and the expanded use of coal.

61612 (CONF-8110215—, pp 95-104) **Economic impact of taxes on selected eastern coal states.** Nicholson, A.F. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This paper describes the tax loads and insurance obligations carried by coal producers in three major eastern coal-producing states and suggests how the industry may deal with the existing situations. (PSB)

61613 (CONF-8110215—, pp 105-111) **Impact of fiscal changes on the transportation sector.** Walsh, R.F. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This paper discusses potential changes in transportation energy efficiency and use which may result from changes in federal policies and programs. Proposed budgetary and tax changes are summarized projected impacts in areas of highways, mass transit, airports, railroad passenger and freight operations, and deep draft and inland waterways. (PSB)

61614 **(NP—2903936) Report of an econometric study of the energy sector of Alabama.** Hooks, D.L.; Cheng, D.C. (Alabama Univ., University (USA). Natural Resources Center). Aug 1979. 63p. NTIS, PC A04/MF A01. Order Number DE82903936.

Portions of document are illegible.

The purposes of the research project are: the collection of energy-related economic data, the estimation of relationships among energy demand and supply and the Alabama economy, and the development of the capability to simulate the effects of alternative developments in the energy sector upon the state's economy. An overview of alternative economic models that are widely used for forecasting and simulation purposes is presented and the Alabama Econometric Model is described. Two examples of simulation models of Alabama coal production and some results are given, followed by the presentation of several simulations of Alabama energy use. Some possible applications of the models that have been developed and future research projects are described. The appendix presents the data used to estimate the models constructed. (MCW)

61615 **Canada and Mexico: the comparative and joint politics of energy.** Feldman, E.J.; Costain, W.D.; Hampson, F.; McKinsey, L. Cambridge, MA; University Consortium for Research on North America (1981). 76p. (CONF-8104175—Summ.). Univ. Consortium for Research on North America, 1737 Cambridge St., Cambridge, MA 02138 $3.25.

From Joint Canadian/Mexico symposium on comparative and joint politics of energy; Boston, MA, USA (9 Apr 1981).

Topics covered at the symposium include: the national energy policies; political constraints on national policies; the production of electricity, potential for international cooperation; oil, gas, and synthetic fuels, development and exchange; academic views of North America; the future of energy for Canada and Mexico. (GHT)

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 60838, 61611, 61627, 61628, 61702, 61968, 62014, 62026, 62044, 62053

61616 **(AECL—7404) Risk, fear and public safety.** Siddall, E. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). Apr 1981. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702467.

Part 1 of the paper advocates a rational approach to public safety based on unbiassed quantitative assessment of overall risks and benefits of any technological activity. It shows that improved safety should be attainable at less cost than is the case at present. Part 2 offers an explanation of why so little has been achieved in this direction and outlines the major errors in present practices. Part 3 suggests what might realistically be done towards the achievement of some of the possible benefits. Factors which are important in the study of safety and evidence supporting the arguments are discussed in six appendices. It is urged that the scientific and technological community should improve its understanding of safety as a specialization and should endeavour to lead rather than follow in our present political system.

61617 (CONF-8110215—, pp 34-38) **Illinois coal and future air quality regulations.** Greene, K. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

The author reviews the flaws of implementation of the current Clean Air Act and urges that a pollution budget be enacted for 2 reasons: stimulation of research and development for cleaning high-sulfur coal and for design and efficiency maximization for pollution control technology. (PSB)

61618 (CONF-8110215—, pp 39-42) **Clean Air Act: an attempt to return to balance.** Kontnik, L.T. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

The speaker identifies the key legislative issues being debated for proposed modification of the Clean Air Act and comment on Edison Electric Institute's position on each. He urges a long term solution aimed at giving more authority for implementation to the States, especially in emergency energy supply shortages. (PSB)

61619 (CONF-8110215—, pp 43-45) **Long range transport and acid rain.** Semonin, R.G. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This author concludes from a scientific viewpoint that available evidence does not warrant stricter emission requirements than those already in place. He feels resources would be better directed improving scientific knowledge linking presumed precursor sources, acid rain receptors, and effects and ecological systems; only then will accelerated abatement spending be economically sound. (PSB)

61620 **(EPRI-EA—2540-Vol.1) Acid deposition: decision framework. Volume 1. Description of conceptual framework and decision-tree models. Final report.** Balson, W.E.; Boyd, D.W.; North, D.W. (Decision Focus, Inc., Palo Alto, CA (USA)). Aug 1982. 114p. NTIS, PC A06/MF A01. Order Number DE82906492.

Acid precipitation and dry deposition of acid materials have emerged as an important environmental issue affecting the electric utility industry. This report presents a framework for the analysis of decisions on acid deposition. The decision framework is intended as a means of summarizing scientific information and uncertainties on the relation between emissions from electric utilities and other sources, acid deposition, and impacts on ecological systems. The methodology for implementing the framework is that of decision analysis, which provides a quantitative means of analyzing decisions under uncertainty. The decisions of interest include reductions in sulfur oxide and other emissions thought to be precursors of acid deposition, mitigation of acid deposition impacts through means such as liming of waterways and soils, and choice of strategies for research. The report first gives an overview of the decision framework and explains the decision analysis methods with a simplified caricature example. The state of scientific information and the modeling assumptions for the framework are then discussed for the three main modules of the framework: emissions and control technologies; long-range transport and chemical conversion in the atmosphere; and ecological impacts. The report then presents two versions of a decision tree model that implements the decision framework. The basic decision tree addresses decisions on emissions control and mitigation in the immediate future and a decade hence, and it includes uncertainties in the long-range transport and ecological impacts. The research emphasis decision tree addresses the effect of research funding on obtaining new information as the basis for future decisions. Illustrative data and calculations using the decision tree models are presented.

61621 **(LA—9458-T) Economic and regulatory efficiency in air-pollution control.** Kolstad, C.D. (Los Alamos National Lab., NM (USA)). Jul 1982. Contract W-7405-ENG-36. 258p. NTIS, PC A12/MF A01. Order Number DE82021149.

Thesis. Submitted to Stanford Univ., CA.

This dissertation provides a bridge between oversimplified analyses of regulatory alternatives and undersimplified perceptions of the air pollution problems by regulators. Some of the more critical realistic aspects of air pollution such as time-varying pollutant transport, locational aspects of pollution control, demand for goods jointly produced with pollution, and uncertainty are discussed. Optimal levels and distribution of pollution as well as the efficiency of alternate regulatory structures in achieving optimality are explored.

2904 Natural Resources

REFER ALSO TO CITATION(S) 61175, 61647, 61650, 61651, 61652, 61653, 62026

61622 (AD-A—112675/4) Significance of seabed resources for the United States in 1990. Final report. (Military Intelligence Detachment (432nd) (Strategic), Fort Wadsworth, NY (USA)). 15 Jun 1976. 80p. NTIS, PC A05/MF A01.

This report investigates the immense potential of seabed resources to meet the world's increasing demand for raw materials. It surveys recent efforts by international bodies to define ocean areas and to agree upon the rules and limits of national access to and exploitation of these resources. Finally, the study projects the significance of seabed resources to the year 1990.

61623 Hazards of the international energy crisis. Carlton, D.; Schaerf, C. (eds.). New York, NY; St. Martin's Press, Inc. (1982). 220p. (CONF-7808138—). St. Martin's Press, Inc., 175 Fifth Avenue, New York, NY 10010.

From 7. course of the international school disarmament and research on conflicts; Ariccia, Italy (18 Aug 1978).

Individual chapters are included in the data base. (PSB)

61624 1981 spring annual conference and World Productivity Congress: proceedings. Norcross, GA; American Institute of Industrial Engineers, Inc. (1981). 811p. (CONF-810538—). American Institute of Industrial Engineers, Inc., 25 Technology Park/Atlanta, Norcross, GA 30092.

From Spring AIIE conference; Detroit, MI, USA (17 May 1981).

Separate abstracts were prepared for seven papers presented at the proceedings and will appear in Energy Research Abstracts; six papers will appear in Energy Abstracts for Policy Analysis. One paper had previously appeared in the DOE data base. One hundred and five papers were considered out of scope of DOE data base. (MCW)

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 61637, 61659

61625 Economic analyses at early stages of technology development. Cummings, R.G. (Univ. of New Mexico, Albuquerque); Schulze, W.D. *Resources and Energy;* **4**: No. 2, 105-119(Jun 1982). Contract AS04-79ET27017.

This paper is concerned with the use of economic analysis to aid in allocating research and development funds both between alternative energy sources and within a particular technology. Examples are given of the role of early economic-feasibility analysis for new solar and geothermal technologies. 2 references, 6 figures.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 60913, 60965, 60979, 60994, 61370, 61371, 61372, 61476, 61654

61626 (INIS-mf—6844) Comments on the report of the enquiry commission on future nuclear policies. (Bundesverband der Deutschen Industrie e.V., Koeln (Germany, F.R.)). Feb 1981. 34p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82780741.

The recommendations of the enquiry commission are reviewed, its efforts are appreciated and judged positively, but there are five weak points which are critically commented upon.

61627 Radiation hazards in fission fuel cycles. Rotblat, J. pp 107-126 of Hazards of the international energy crisis. Carlton, D.; Schaerf, C. (eds.). New York, NY; St. Martin's Press, Inc. (1982).

From 7. course of the international school disarmament and research on conflicts; Ariccia, Italy (18 Aug 1978).

A summary of radiation hazards from all parts of the nuclear fuel cycle is given in terms of the UNSCEAR estimates of the collective dose commitment. The author notes that at present time this radiation hazard is negligible (less than background fluctuations); however, he warns that by the year 2000, the dose will become significant. (PSB)

61628 Evolutionary strategy for nuclear power. Feiveson, H.A.; von Hippel, F.; Williams, R.H. (Princeton Univ., NJ). pp 127-168 of Hazards of the international energy crisis. Carlton, D.; Schaerf, C. (eds.). New York, NY; St. Martin's Press, Inc. (1982).

From 7. course of the international school disarmament and research on conflicts; Ariccia, Italy (18 Aug 1978).

This chapter explores the role of such alternative systems in the development of nuclear power in the US and elsewhere. Rationale is given for making proliferation resistance a design criterion for nuclear energy system and the value of isotopic-denaturing of reactor fuel in achieving such proliferation resistance. Uranium efficiency and economics of power generation for the alternative reactor systems are considered. Evolutionary strategy is detailed for nuclear power development for the US and the world. (PSB)

61629 Cleanup efforts at Three Mile Island. Hearing before the Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, House of Representatives, Ninety-Seventh Congress, First Session, March 30, 1981. Washington, DC; Government Printing Office (1982). 75p. GPO.

Bruce Babbitt, Governor of Arizona and chairman of the Nuclear Safety Oversight Committee, Rep. Allen Ertel of Pennsylvania, and Susan Shanaman, chairman of the Pennsylvania Public Utilities Commission, testified on the cleanup effort at Three Mile Island and the allocation of liability for the accident. Babbitt's comments emphasized his committee's concern over the lack of a clear policy on safety issues. Among other things, this hearing discussed funding for the cleanup and for handling high-level radioactive wastes and the lack of progress in either area. (DCK)

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 61252, 61731, 61732

61630 (P—500-82-005) Cogeneration in municipalities. Workshop proceedings for local governments and municipal utilities. Patterson, S. (ed.). (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Jan 1982. 71p. NTIS, PC A04/MF A01. Order Number DE82905758.

Five papers from workshops for local governments and municipal utilities are included. A separate abstract was prepared for each one.

61631 (P—500-82-005, pp 32-38) Steps to successful permitting of cogeneration projects. Bass, R.; Fickett, K. Jan 1982. NTIS, PC A04/MF A01.

In Cogeneration in municipalities. Workshop proceedings for local governments and municipal utilities.

The benefits of cogeneration are listed. The role of the Office of Permit Assistance and the Cogeneration Desk is described. The agencies involved in the regulation of cogeneration are listed. Air quality is discussed as the greatest environmental concern.

61632 (P—500-82-005, pp 39-58) Financing cogeneration systems. Moran, E.; Weinress, J. Jan 1982. NTIS, PC A04/MF A01.

In Cogeneration in municipalities. Workshop proceedings for local governments and municipal utilities.

The assessment of financial risks associated with a particular project and finding ways of mitigating those risks and developing a credit support framework are dicsussed. Sources of financing are described.

61633 (P—500-82-005, pp 59-67) **Tax-exempt funding for cogeneration facilities by municipal governments.** Swan, S.L. Jan 1982. NTIS, PC A04/MF A01.

In Cogeneration in municipalities. Workshop proceedings for local governments and municipal utilities.

Three major forms of exempt financing a municipality could use are discussed: revenue bonds, non-profit corporation lease leaseback bonds, and joint exercise of powers lease rental bonds. Advantages and legal issues involved in each type are explored.

2910 Conservation

REFER ALSO TO CITATION(S) 61670, 61686, 61693, 61694, 61695, 61697, 61698, 61701, 61702, 61706, 61711, 61715

61634 (CONF-8110215—, pp 82-87) **Impact of regulation on conservation.** Millhone, J.P. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This paper discusses both administrative policy and public opinion of regulatory efforts to force energy conservation in residential and commercial services. Regulatory methods, though not favored by this administration, have not been repealed; they stand ready for implementation should the crises need arise. (PSB)

61635 (CONF-8110215—, pp 88-92) **Impact of regulation on energy consumption on transportation.** Rappaport, C.S. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This paper discusses the interrelationships between energy and the economy in the transportation sector. Discussion centers on policy changes relative to deregulation of energy prices and the energy conservation efforts. (PSB)

61636 (DOE/CS/22804—1-Vol.3) **Innovative financing for energy-efficiency improvements. Phase I report.** Klepper, M.; Schwartz, H.K.; Feder, J.M.; Smith, D.C.; Green, R.H.; Williams, J.; Sherman, J.L.; Carroll, M. (Lane and Edson, P.C., Washington, DC (USA)). Jan 1982. Contract AC02-81CS22804. 156p. NTIS, PC A08/MF A01. Order Number DE82009970.

Portions of document are illegible.

The use of utility-assisted financing, tax-exempt financing, bank financing, leasing, and joint venture financing to promote energy efficiency investments for each of three different categories of buildings (multifamily, commercial, and industrial) is discussed in separate chapters. (MCW)

61637 (TVA—2903917) **Energy management annual report, Fiscal Year 1981.** Steffy, R.C. Jr. (Tennessee Valley Authority, Chattanooga (USA)). 1 Mar 1982. 77p. NTIS, PC A05/MF A01. Order Number DE82903917.

Portions of document are illegible.

Data in this report reflects TVA's efforts toward energy conservation, detailed through its general utility operations and through its related energy conservation programs, projects, and demonstrations which began in 1973. An internal energy management plan was developed for implementation of Executive Order No. 11912 as modified by Executive Order No. 12003, the National Energy Act of 1978, and the Federal Energy Management and Planning (FEMP) Program (10 CFR Part 436). The document established energy performance goals and objectives for all TVA operations and buildings. Energy conservation efforts include general transportation, industrial operations, utilities operations, administrative operations, and research and development operations. Conservation efforts owned and leased buildings are detailed in Section IV. Related activities include various energy conservation programs, demonstration programs, and solar and other renewable resource programs. Energy use data for buildings and fuel used by activities is summarized in attachments 1 through 4. (PSB)

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 60822, 60856, 60858, 61604, 61607, 61614, 61709, 61737

61638 (AD-A—105629) **Value tree analysis of energy supply alternatives.** Stillwell, W.G.; Vonwinterfeldt, D.; John, R.S. (University of Southern California, Los Angeles (USA)). Jun 1981. 41p. NTIS, PC A03/MF A01.

The use of value trees in multiattribute evaluations of energy supply alternatives was examined. A value tree relating general values and concerns to specific value relevant attributes was constructed to compare three energy options: nuclear, coal, and a combined geothermal and conservation package. Both hierarchical and non-hierarchical weighting procedures were used to rate the energy options. Several additive multiattribute models were constructed and compared with holistic rankings and ratings of the three options. Three basic findings were: (1) hierarchical weights were steeper than non-hierarchical weights (2) groups identified by their holistic first choice showed substantial agreement in their assessment of attribute weights (3) convergence of MAU model parameters resulted in a common model , consistent with holistic evaluations of the pro-conservation group, and generally inconsistent with those of the pro-nuclear group. This differential consistency between model composites and holistic evaluations is interpreted as a result of weight parameter distortions due to social desirability and a neglect to consider attribute value ranges when making weight judgments.

61639 (AECL—7429) **Canadian heavy water production, 1970 to 1980.** Galley, M.R.; Bancroft, A.R. (eds.). (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1981. 113p. (CONF-811007—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82780745.

From 2. world congress of chemical engineering; Montreal, Canada (4 Oct 1981).

Separate abstracts are included in the data base.

61640 (CONF-8110215—, pp 155-161) **Illinois and energy: a need for new partnerships.** Massey, W.E. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

The author discusses long-range need for research and development for assuring stable energy supplies. (PSB)

61641 (LA—9485-MS) **DoD energy vulnerabilities: potential problems and observations.** Freiwald, D.A.; Berger, M.E.; Roach, J.F. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 52p. NTIS, PC A04/MF A01. Order Number DE82021140.

The Department of Defense is almost entirely dependent on civilian energy supplies to meet its needs in both peacetime and periods of heightened conflict. There are a number of potential vulnerabilities to the continual and timely supply of energy to both the civilian and military sectors. These include denial of the energy resources themselves, disruption of critical transportation networks, destruction of storage facilities, and interruption of electrical power. This report briefly reviews the present situation for provision of energy from the civilian sector to the military. General vulnerabilities of the existing energy supply system are identified, along with the potential for armed aggression (including terrorist and sabotage activities) against the energy network. Conclusions and some tentative observations are made as to a proper response to the existing vulnerabilities.

61642 (DOE/IA/10150—T1) **Foreign energy supply assessment and program (FESAP).** (Anathon Corp., Boston, MA (USA)). [nd]. Contract AC01-81IA10150. 311p. NTIS, PC A14/MF A01. Order Number DE82014492.

Portions of document are illegible.

The in-place oil and gas potential for Libya and Egypt have been calculated. This includes both the discovered and undiscov-

ered hydrocarbon resources. The area was subdivided into its geological basins for which the resources were calculated. For offshore areas the calculations included an area out to a water depth of 200 meters.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 60839, 60840, 61172, 61184, 61607, 61621, 61634, 61635, 61638, 61639, 61655, 61656, 61657, 61664, 61669, 61671, 62025, 62026

61643 **(CONF-8110215—) Illinois energy policy: new directions for the eighties. Proceedings of the ninth annual Illinois energy conference.** (Illinois Univ., Chicago (USA). Energy Resources Center). 1981. Contract FG01-81FE16116. 167p. NTIS, PC A08/MF A01. Order Number DE82018954.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

Individual papers are included in the data base. (PSB)

61644 (CONF-8110215—, pp 16-20) **Taxation, incentives and fiscal policy.** Toder, E.J. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This paper discusses general perspectives on tax policy toward energy markets and the relationship of potential changes in energy tax policy to the Administration's overall economic, energy, and tax policies. Discussion centers around special tax incentives for energy production and conservation through their history and reasons for enactment. It concludes that these incentives are now obsolete. (PSB)

61645 (CONF-8110215—, pp 21-24) **Natural resources and the environment.** Russell, D. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

Policy changes under Interior Secretary James Watt are reviewed. Examples are the 5-year oil and gas leasing program on the Outer Continental Shelf with a purpose to achieve national energy independence from foreign sources. The local use of geothermal energy as well as the current philosophy on wilderness preservation are also discussed. (PSB)

61646 (CONF-8110215—, pp 76-81) **Deregulation of natural gas prices.** Eberst, C.R. Jr. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

Issues are discussed which surround natural gas price deregulation and recent legislative proposals to decontrol natural gas. Past legislation as well as current law is reviewed in the light of the current political climate. (PSB)

61647 (CONF-8110215—, pp 128-133) **Impact of new energy policies on Illinois industry.** Ranney, G.A. Jr. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This paper discusses the plan for managing Illinois' mineral resources to obtain maximum economic growth, and the education needed for wise decision making for policy directions. (PSB)

61648 (CONF-8110215—, pp 143-149) **New energy approach: let the people decide.** Chiles, J.H. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

The policy of this administration for letting the free market determine energy demand and thereby supply is discussed. Through such a policy the American people will balance factors of convenience, price, availability, environmental concerns, and reliability of supply among other things before choosing an individual energy source. No panacea is promised. (PSB)

61649 **(NP—2905974) 1981 legal report of oil and gas conservation activities.** (Interstate Oil Compact Commission, Oklahoma City, OK (USA)). 1982. 37p. Interstate Oil Compact Commission, P.O. Box 53127, Oklahoma City, OK 73152.

Legislative, administrative, and judicial actions are described for 28 states of the USA and for the Canadian provinces of Alberta and British Columbia where significant legal activities dealing with oil and gas conservation during the year of 1981 occurred. The states covered are: Alabama, Alaska, Arizona, Arkansas, California, Colorado, Georgia, Idaho, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Missouri, Montana, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Virginia, and West Virginia. (LEW)

61650 **(USGS-OFR—81-1256) Permit requirements for development of energy and other selected natural resources for the state of Idaho.** (Dearborn Associates, Inc., Seattle, WA (USA)). Aug 1981. 92p. Geological Survey, Open-File Services Section, Denver Federal Center, Box 25425, Denver, CO 80225.

This guidebook summarizes environmental and land-use permits issued by the state for the development of energy and other natural resources. The guidebook is intended not only for private developers and interest groups, but also for regulatory officials of federal, state, and local government as well. The guidebook is divided into seven sections: Introductory Information; Consolidated Permit Programs, Local Regulatory Policies; Resource Extraction; Land Use Regulation; Environmental Quality Management; and Social/Ecological Preservation. Each section is divided into chapters; each chapter summarizes one permit, license, or approval. Permits administered by a single agency are generally grouped together in each section. (PSB)

61651 **(USGS-OFR—81-1269) Permit requirements for development of energy and other selected natural resources for the state of New Mexico.** (Camp Dresser and McKee, Inc., Wheat Ridge, CO (USA)). Aug 1981. 71p. Geological Survey, Open-File Services Section, Denver Federal Center, Box 25425, Denver, CO 80225.

This guidebook summarizes environmental and land-use permits issued by the state for the development of energy and other natural resources. The guidebook is intended not only for private developers and interest groups, but also for regulatory officials of federal, state, and local government as well. The guidebook is divided into seven sections: Introductory Information; Consolidated Permit Programs, Local Regulatory Policies; Resource Extraction; Land Use Regulation; Environmental Quality Management; and Social/Ecological Preservation. Each section is divided into chapters; each chapter summarizes one permit, license, or approval. Permits administered by a single agency are generally grouped together in each section. (PSB)

61652 **(USGS-OFR—81-1270) Permit requirements for development of energy and other selected natural resources for the state of New York.** (Lawson (Barry) Associates, Inc., Boston, MA (USA)). Sep 1981. 74p. Geological Survey, Open-File Services Section, Denver Federal Center, Box 25425, Denver, CO 80225.

This guidebook is to summarizes environmental and land-use permits issued by the state for the development of energy and other natural resources. The guidebook is intended not only for private developers and interest groups, but also for regulatory officials of federal, state, and local government as well. The guidebook is divided into seven sections: Introductory Information; Consolidated Permit Programs, Local Regulatory Policies; Resource Extraction; Land Use Regulation; Environmental Quality Management; and Social/Ecological Preservation. Each section is divided into chap-

ters; each chapter summarizes one permit, license, or approval. Permits administered by a single agency are generally grouped together in each section. (PSB)

61653 **(USGS-OFR—81-1274) Permit requirements for development of energy and other selected natural resources for the state of Ohio.** (Lawson (Barry) Associates, Inc., Boston, MA (USA)). Sep 1981. 54p. Geological Survey, Open-File Services Section, Denver Federal Center, Box 25425, Denver, CO 80225.

This guidebook summarizes environmental and land use permits issued by the state for the development of energy and other natural resources. The guidebook is intended not only for private developers and interest groups, but also for regulatory officials of federal, state, and local government as well. The guidebook is divided into seven sections: Introductory Information; Consolidated Permit Programs, Local Regulatory Policies; Resource Extraction; Land Use Regulation; Environmental Quality Management; and Social/Ecological Preservation. Each section is divided into chapters; each chapter summarizes one permit, license, or approval. Permits administered by a single agency are generally grouped together in each section. (PSB)

61654 **Nuclear energy and proliferation.** Rotblat, J. pp 66-106 of Hazards of the international energy crisis. Carlton, D.; Schaerf, C. (eds.). New York, NY; St. Martin's Press, Inc. (1982).

From 7. course of the international school disarmament and research on conflicts; Ariccia, Italy (18 Aug 1978).

The nuclear fuel cycle is examined to determine how a government could covertly acquire a sufficient amount of fissile material to make a nuclear bomb. The fast breeder reactor is seen as having much greater potential for proliferation than the thermal reactors. The author sees the removal of the threat of horizontal proliferation as the only chance for mankind survival. (PSB)

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 60819, 60828, 60829, 60838, 60841, 60845, 60846, 60847, 60855, 60856, 60858, 60859, 60859, 60884, 61608, 61612, 61641, 61642, 61646, 61668, 61668, 61669

61655 (CONF-8110215—, pp 11-15) **Changing regulatory scene.** Means, R.C. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

In assessing impacts from the Natural Gas Policy Act (NGPA) of 1978, the author stresses the fundamental distinction between the partial regulation of natural gas before the Act and that which will exist after December 31, 1984. Before NGPA sales into the interstate market were regulated; sales within the intrastate market were not. Under NGPA complete deregulation of more than half the supply of natural gas will coexist in the same market with continued price controls on the remaining supply. The author sees direct economic benefits of the low-priced regulated gas going to producers of deregulated gas through the competitive bedding process, rather than to consumers. Under complete deregulation his analysis shows the consumer fares the same with regional suppliers' profits more evenly distributed than under NGPA. (PSB)

61656 **(GAO/CED—81-145) Comments on Interior's surface mining regulations.** (General Accounting Office, Washington, DC (USA). Community and Economic Development Div.). 5 Aug 1981. 18p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

A review was conducted of the Office of Surface Mining's (OSM) regulations for implementing the Surface Mining Control and Reclamation Act of 1977. The findings of the study as well as recommendations are presented. The objective was to determine if key regulations provided adequate environmental protection while allowing states and coal mine operators sufficient flexibility to choose the appropriate methods necessary to achieve the act's environmental goals at the least cost. The review consisted of interviewing officials of four State natural resource agencies (Colorado, Pennsylvania, West Virginia, and Wyoming), four coal associations, two coal companies, two environmental groups, one bonding association, the National Academy of Sciences, the Environmental Protection Agency, the Bureau of Mines, and OSM. During our review we also (1) analyzed technical data supporting surface mining regulations and responses to proposed regulations, (2) identified studies on cost/benefit analysis of environmental regulations and selected surface mining regulations, (3) reviewed the legislative history to determine the intent of the surface mining act, and (4) reviewed pertinent records, documents, and books at federal agencies. (DMC)

61657 **(GAO/EMD—81-119) Mining on National Park Service lands: what is at stake.** (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 24 Sep 1981. 59p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

Report to the Chairman, Subcommittee on Mines and Mining, House Committee on Interior and Insular Affairs of the United States.

The Department of the Interior recommended to the Congress in 1979 that mining claims on certain National Park Service lands be acquired for environmental protection. GAO found that these recommendations were based on vague and misleading environmental and cost data and, if implemented, could result in costs substantially in excess of the reported estimates. GAO believes that the Congress should defer any action to acquire mining claims on these National Park Service lands. GAO recommends that the Department notify the Congress that it no longer supports these outstanding recommendations and submit more thorough analysis of the need and costs of acquiring these claims. GAO also found that Interior did not fully analyze the mineral supply implications of its recommendations. Specifically, Interior failed to assess adequately the effects of acquiring the mining claims on the US need for the minerals and the cost to replace them from other sources. The National Park Service now states that current mining regulations have ensured that mining on these park lands is occurring in an environmentally acceptable manner. However, NPS had not considered less costly means of achieving the same results. This is particularly true for Death Valley National Monument, an area historically and currently important for mineral production.

61658 **(GAO/EMD—81-128) Unresolved issues resulting from changes in DOE's synthetic fuels commercialization programs.** (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 17 Aug 1981. 18p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

The administration's proposed synthetic fuels program is reviewed by examing authorizing legislation, the previous and current administration's respective budgets, budget testimony, and other relevant program documents. Discussion is presented under the following headings. DOE's role in commercialization will end; phase out of DOE's pilot and demonstration plants; DOE's new focus long-term R and D; and environmental efforts associated with the synthetic fuels program. Based on the results, the Comptroller General recommends that the Secretary of Energy establish specific definitions for long-term, high risk, high-payoff programs and direct that they be consistently applied to funding current and future R and D projects. He further recommends that the Chairman, Synthetic Fuels Corporation, publish proposed guidance for implementation of Section 131(e) of the Energy Security Act; invite comments on the proposed guidance from all interested parties including DOE, EPA, and State environmental agencies; and publish final guidance, after confirmation of a Board of Directors, which considers the comments.

61659 **(GAO/EMD—82-23) Government support for synthetic pipeline gas uncertain and needs attention.** (General Accounting Office, Washington, DC (USA). Program Analysis Div.). 14 May 1982. 139p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

Report to the Secretary of Energy.

GAO identifies DOE synthetic pipeline coal gas research and development which could be left to industry. Recent congressional budget cuts and further DOE proposals, if enacted, will eliminate much of the R and D. Also, the Department's environmental

research has been cut back beyond what industry will be required to perform, and leave a gap in needed efforts. Because DOE's support for large scale demonstration projects has been eliminated, sponsors will likely have to look to the newly created Synthetic Fuels Corporation for Government financial assistance. GAO identifies obstacles facing commercial projects and makes recommendations for focusing the Department's research and development, providing necessary environmental research and furthering consideration of coal gasification demonstrations.

61660 **(GAO/GGD—82-48) Uncertainties about the definition and scope of the property concept may reduce windfall profit tax revenues.** (General Accounting Office, Washington, DC (USA). General Government Div.). 13 May 1982. 22p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

Report to the Secretary of the Treasury.

The Crude Oil Windfall Profit Tax Act of 1980 contains a target revenue amount - $227 billion - to be collected over approximately a 10-year period. The basic determinant of the windfall profit tax rate is property, a concept which the act incorporates by reference to Department of Energy regulations. The property concept is singularly important because it controls the category or tier of crude oil which, in turn, establishes the applicable windfall profit tax rate, ranging from 30% to 70%. Notwithstanding its significance, there is considerable uncertainty over the property concept within both IRS and the oil industry. IRS has suspended certain examinations pending development of more definitive guidance. Similarly, some oil companies have raised questions about the reference year for making property determinations and about the scope of the property concept. Uncertainty over the meaning of a cornerstone term promotes neither voluntary compliance nor effective IRS examinations. Thus, Treasury and IRS need to quickly resolve uncertainties over the property concept.

61661 **Oil shale 1982: a technology and policy primer.** Golden, CO; Colorado School of Mines (Nov 1981). 92p.

An updated policy primer and technology assessment of the oil shale industry is presented for the benefit of policy makers and the general public. Methods for the development, management, and use of energy are discussed. The biological, economic, social, and political impacts and controversies surrounding current and future energy related activities are considered. Mining methods, retort processing, and methods for disposing of the shale are also discussed.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 60750, 61033

2960 Electric Power

REFER ALSO TO CITATION(S) 61045, 61053, 61054, 61239, 61263, 61266, 61740

61662 (CONF-8110215—, pp 49-75) **Alternate responses to the financial crisis in the electric utility industry.** Bauer, D.C. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

This paper discusses the economic state of the industry as regards its present financial condition; construction commitments and requirements; expenditures and financial requirements (1981 to 1990); construction in the 1990s; effects of the 1981 Economic Recovery Tax; external financing; regulatory reform; licensing nuclear stations now under construction; taxation; rate and financial regulation; technical efficiency; diversification; and deregulation. An appendix with 15 tables summarizes the financial position of the industry. (PSB)

61663 **(DOE/EIA—0346) Effects of new plant and equipment expenditures on electricity prices.** Serot, D.E.; Makens, J.W. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Jul 1982. 34p. NTIS, PC A03/MF A01. Order Number DE82021872.

This report examines how electricity prices change over time and how expenditures for new plant and equipment influence the price path. Electricity prices are set by Public Utility Commissions so that the total revenue from the sales of electric power just equals the cost of producing that power. This means that the average unit price of electricity equals the average unit cost of production.

61664 **(EPRI-EA—2552) Heuristic analysis of industry and economic effects of restrictions on generating capacity. Final report.** Hudson, E.A.; Kimball, C.E. (Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). Aug 1982. 115p. NTIS, PC A06/MF A01. Order Number DE82906491.

A previous study, Industry and Economic Impacts of Restrictions on the Growth of Generating Capacity (EPRI Report, EA-1775), developed and applied an electricity-energy-economy modeling system to explore the effects of restrictions on nuclear and coal generating capacity and of varying capacity cost and fuel cost conditions. The present study develops a much more simple form (a heuristic model) of this detailed modeling system and applies this simple model to explain the previous results and to demonstrate the types and magnitudes of the causal relationships involved. As well as laying out some of the key relationships in the electricity-energy-economy modeling system, this simple model may be useful in permitting other analysts to perform their own studies, using new data and new information on possible restrictions, to estimate the effects caused by restrictions applying to the electric power industry.

61665 **(EPRI-EA—2566-SR) Mathematical generation-planning models using decomposition and probabilistic simulation.** Bloom, J.A. (Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1982. 364p. NTIS, PC A16/MF A01. Order Number DE82906493.

This report gives the underlying mathematical development of a method of planning for generation capacity. The method, incorporated in EPRI's Electric Generation Expansion Analysis System (EGEAS), is referred to there as the Generalized Benders method. Initial computation experience is given, and it shows that the method is accurate and efficient. The method makes use of linear programming, mathematical decomposition, and nonlinear production costing with probabilistic representation of generator outages. Production costing is given with two approaches, first with the Booth-Baleriaux equivalent load duration curve and then with its representation by the Gram-Charlier series of cumulants. The planning method defines marginal costs that take into account generator outages. Hydroelectric, limited-energy storage plants and renewable technologies are included.

61666 **(EPRI-EL—2561-Vol.1) Electric-generation-expansion analysis system. Volume 1: solution techniques, computing methods, and results. Final report.** Caramanis, M.C.; Schweppe, F.C.; Tabors, R.D. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Aug 1982. 301p. NTIS, PC A14/MF A01. Order Number DE82906479.

EGEAS is a modular state-of-the-art capacity expansion software package. It contains five capacity expansion analysis options ranging from preliminary analysis tools based on screening curves and linear programming to sophisticated non-linear analysis tools utilizing a Generalized Benders' Decomposition algorithm and a Dynamic Programming algorithm. A stand alone, detailed probabilistic production costing algorithm is also available for prespecified expansion plan production cost and reliability analysis. The multiple EGEAS analysis options are incorporated into a single control analysis program allowing users to match the analysis option selected to a particular problem's requirements and complexity. At the same time, the implementation of a flexible modular and extendable data base common to all five analysis options simplifies data input and maintenance, and rules out input-related inconsistencies among

the analysis options. The development and implementation of a detailed but nevertheless efficient probabilistic production costing algorithm made possible the addition to EGEAS of a number of advanced features. These features include maintenance scheduling, economy interchange and reserve sharing, storage and limited energy unit modeling as well as Non-Dispatchable Generation and Load Management analysis. Sensitivity, uncertainty and trade-off analyses are also available in EGEAS. The structure and capabilities of EGEAS as well as the results of a testing and validation effort exercise are presented in this Volume, No. 1.

61667 **(EPRI-EL—2561-Vol.2) Electric-generation-expansion analysis system. Volume 2: details of solution techniques, data of test systems, and glossary of terms. Final report.** Caramanis, M.C.; Schweppe, F.C.; Tabors, R.D. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Aug 1982. 198p. NTIS, PC A09/MF A01. Order Number DE82906477.

EGEAS is a modular state-of-the-art capacity expansion software package. It contains five capacity expansion analysis options ranging from preliminary analysis tools based on screening curves and linear programming to sophisticated non-linear analysis tools utilizing a Generalized Beners' Decomposition algorithm and a Dynamic Programming algorithm. A stand alone, detailed probabilistic production costing algorithm is also available for prespecified expansion plan production cost and reliability analysis. The multiple EGEAS analysis options are incorporated into a single control analysis program allowing users to match the analysis option selected to a particular problem's requirements and complexity. At the same time, the implementation of a flexible modular and extendable data base common to all five analysis options simplifies data input and maintenance, and rules out input-related inconsistencies among the analysis options. The development and implementation of a detailed but nevertheless efficient probabilistic production costing algorithm made possible the addition to EGEAS of a number of advanced features. These features include maintenance scheduling, economy interchange and reserve sharing, storage and limited energy unit modeling as well as Non-Dispatchable Generation and Load Management Analysis. Sensitivity, uncertainty and trade-off analyses are also available in EGEAS. This volume, Volume 2, includes mathematical appendices and a detailed description of the three generating systems used for testing and validating EGEAS.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 61608, 61705, 61736

61668 (CONF-8110215—, pp 112-119) **Oil and natural gas supply.** Flom, E.L. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

The author discusses energy needs and forecasts supplies for the year 2000 in the US in terms of petroleum and natural gas. He makes a case for deregulation. (PSB)

61669 **India: energy perspectives.** Arnsdorf, V.; Surana, R. New Delhi, India; Educational Resources Center (1980). 44p. Center for International Programs, NY State Educational Dept., Cultural Educational Center, Rm 9B52, Albany, NY 12230.

Energy sources in India are considered for commercial, noncommercial and new sources. Coal, petroleum and electric power are considered commercial sources; while biomass, wood, and cow manure are the bulk of the non-commercial sources. Economic pressures from rapidly escalating energy costs have encouraged exploration for new sources, including oil and natural gas. Hydroelectric power is also being maximized. (PSB)

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 61053, 61054, 61057, 61058, 61059, 61060, 61074, 61092, 61111, 61144, 61172, 61173, 61175, 61184, 61185, 61187, 61215, 61250, 61734, 61737, 61751

61670 **Mandatory utility financing of conservation and solar measures.** Colton, R.D. *Solar Law Reporter;* 3: No. 5, 767-780(Jan 1982).

Arguments, pro and con, are put forth concerning the questions: (1) do state utility authorities have the power to require utilities to provide services such as mandatory financing of conservation and solar measures; and (2) are services such as conservation and solar efforts subject to state regulation as far as utilities are concerned. Following an introduction, the concept of full energy services is discussed as well as the legal basis for mandatory financing. After consideration of both sides of the issue it is concluded that the role of public utility companies in providing adequate service needs to be redefined. 66 references. (MJJ)

61671 **Case study: Florida mandatory standards.** Beach, C.D.; Kettles, C.M. *Solar Law Reporter;* 3: No. 5, 808-821(Jan 1982).

The introduction of a state standards program (1976) in Florida, administered by the Florida Solar Energy Center (FSEC), is described. Limited to solar collectors, collector manufacturers were not initially required to comply with the standards but most manufacturers joined the program because of competitive pressures and pressures from a federally funded rebate program. Legislative history of the program (beginning in 1974) is described as well as industry compliance and enforcement through the building permit and inspection process. Solar standards and codes, program operation, technical criteria and certification are discussed as well as coordination with national efforts. Objections to the standards as well as possible challenges (none as yet) are considered. The current status of the program is reviewed. It is concluded that, although the state law failed to provide for enforcement of the standards, the FSEC is hopeful that a model enforcement ordinance will eventually be adopted by local governments. 26 references. (MJJ)

30 DIRECT ENERGY CONVERSION

REFER ALSO TO CITATION(S) 61109

61672 **(DOE/TIC/EGC—82/2) Energygrams: brief descriptions of energy technology.** Simpson, W.F. Jr. (ed.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Spr 1982. 95p. NTIS, PC A05/MF A01. Order Number DE82003279.

Energygrams: Brief Descriptions of Energy Technology, is a compilation of technical notes (called Energygrams) published by the Technical Information Center. The Center instituted the Energygram program to help fulfill a mission of the US Department of Energy (DOE) to transfer information and technology generated from DOE-sponsored research to identifiable audiences in industry, education, and federal, state, and local government. The Technical Information Center routinely screens all DOE R and D reports to identify appropriate information. It also coordinates with DOE and DOE laboratory and contractor program managers in identifying research and development projects for the transfer program and in reviewing the technical content of Energygrams before publication. Energygrams are usually one-page illustrated bulletins describing DOE technology or data and telling how to obtain the technical reports or other material on which they are based. Frequently a personal contact is given who can provide program information in addition to the data found in the reports. The compilation is organized by subject categories, and, within each category, Energygrams are presented alphabetically by Energygram title. See the Contents for an overview of the compilation and the Subject Index for more specific topics. The index will be cumulated with each issue by calendar year.

3001 Mhd Generators

61673 (CONF-820612—10) Advances in instrumentation and control for MHD: CDIF update. Miller, M.; Rogers, B. (Mountain States Energy, Inc., Butte, MT (USA)). 1982. Contract AC07-78ID01745. 17p. NTIS (US Sales Only). Order Number DE82017400.

From Symposium on instrumentation and control for fossil energy processes; Houston, TX, USA (7 Jun 1982).

Portions of document are illegible.

During the first 18 months of operation at the DOE, MHD Component Development Integration Facility at Butte, Montana, operating problems and experience have prompted a vigorous program of original innovation and improvement in I and C systems. Problems experienced with the pneumatic solids transport system originally supplied have resulted in the development at CDIF of an original Granular Solids Supply Metering System, capable of delivering 1 to 20 lb/min fly ash to the MHD Ash Injected Combustor. Progress has been made on formulation of a generalized model for this pneumatic solids transport. Also, an on-line solid flow meter was developed. Other original work includes a continuous pressure monitoring system for an MHD generator which resists tap slagging. Improvements have been made in accuracy, reliability and fault diagnosis in air and oxygen flow measurement systems.

61674 (DOE/ET/15614—T1) MHD-generator-component development. Quarterly report, July 1980-September 1980. (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Dec 1980. 118p. NTIS, PC A06/MF A01. Order Number DE81022414.

Portions of document are illegible.

The overall objectives of this program are twofold: to contribute, by appropriate systematic experimental and analytical investigations, to the engineering database necessary for the design and construction of MHD generators at CDIF-scale (50 MW/sub th/) and baseload scale (2000 MW/sub th/), and to design and fabricate specific hardware items to be tested at the CDIF site in Butte, Montana. The overall program consists of a series of inter-related tasks, described as follows: (1) perform experimental investigations related to MHD channel design and performance by testing existing channel hardware and by fabricating and testing new channel hardware; (2) perform experimental investigations related to MHD channel perform and lifetime, with the principal aim of systematically obtaining data on the prototype electrodes for the coal-fired, subsonic, long-duration CDIF Generator 1B3; (3) perform testing on channel loading and control utilizing the supersonic Reference Channel No. 4 and other appropriate channels and/or test modules, at magnetic fields to 4 T; (4) provide for facility operation and maintenance of the Mk VI and Mk VII test bays; (5) design and fabricate the following items of CDIF hardware: CDIF Generator 1B2, CDIF Generator 1B3, CDIF 1B Ash Injection Combustor (AIC), CDIF Generator 1A2, and diagonal current control and load consolidation for the 1A2, 1B2 and 1B3 generators; and (4) compare the performance and durability characteristics of coal-fired versus (Mk VI-type) AIC-fired supersonic channels, using existing facilities at the AERL Haverhill site. Progress is described. (WHK)

61675 (DOE/ID/01745—T1) Environmental monitoring. Annual report. Derby, R.J. (Mountain States Energy, Inc., Butte, MT (USA)). Jul 1982. Contract AC07-78ID01745. 19p. NTIS, PC A02/MF A01. Order Number DE82021559.

Portions of document are illegible.

This document discusses the Environmental Monitoring Program conducted from October 1980 through December 1981 at the Component Development and Integration Facility in Butte, Montana. The monitoring methods, results, and conclusions are summarized for each area of the environmental program.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 60738, 60739, 60742, 60743, 61593, 61594, 61744

61676 (ANL—81-67) Advanced-fuel-cell development. Progress report, October-December 1980. Pierce, R.D.; Arons, R.M.; Dusek, J.T.; Fraioli, A.V.; Kucera, G.H.; Sim, J.W.; Smith, J.L. (Argonne National Lab., IL (USA)). Jun 1982. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01. Order Number DE82021146.

This report describes the fuel cell research and development activities at Argonne National Laboratory (ANL) during the period October through December 1980. These efforts have been directed toward (1) developing alternative concepts for components of molten carbonate fuel cells, and (2) improving understanding of component behavior. The principal focus has been on development of γ-$LiAlO_2$ sinters as electrolyte structures. Green bodies were prepared by tape casting and then sintering β-$LiAlO_2$; this has produced γ-$LiAlO_2$ sinters of 69% porosity. In addition, a cathode prepared by sintering lithiated nickel oxide was tested in a 10-cm square cell. Although the bimodal pore distribution in the cathode successfully provided agglomerates flooded with electrolyte and open pores for gas passage, the cathode dimensional variations prevented good contact with the tile, which was stiffer than normal. The tile was prepared using an improved synthesis procedure, which resulted in high-surface-area γ-$LiAlO_2$ particles; but, because the carbonate content was the same as used in previous tests, the tile was less compliant. The cell had excellent seals because dimensional changes associated with in situ cathode reactions were eliminated.

61677 (ANL—82-40) Advanced-fuel-cell development. Progress report, April-June 1981. Pierce, R.D.; Arons, R.M.; Dusek, J.T.; Fraioli, A.V.; Kucera, G.H.; Sim, J.W.; Smith, J.L. (Argonne National Lab., IL (USA)). Aug 1982. Contract W-31-109-ENG-38. 24p. NTIS, PC A02/MF A01. Order Number DE82021272.

This report describes fuel cell research and development activities at Argonne National Laboratory (ANL) during the period April through June 1981. These efforts have been directed toward (1) improving understanding of component behavior in molten carbonate fuel cells, and (2) developing alternative concepts for components. The principal focus has been on the development of sintered γ-$LiAlO_2$ electrolyte supports, stable NiO cathodes, and hydrogen diffusion barriers. Cell tests were performed to assess diffusion barriers and to study cathode voltage relaxation following current interruption.

61678 (DOE/ER/04693—T3) Defect interactions at high concentrations in solid-oxide electrolytes. Progress report, August 10, 1981-July 31, 1982. Nowick, A.S. (Columbia Univ., New York (USA). Henry Krumb School of Mines). 1982. Contract AC02-78ER04693. 19p. NTIS, PC A02/MF A01. Order Number DE82019257.

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The present project has as its main purpose the study of the nature of defects and their interactions in oxygen-ion solid electrolytes having the fluorite (or fluorite related) structure. Of all the materials in this category, ceria (CeO_2) doped with lower-valent (2^+ and 3^+) cations has been the most lucrative. First of all, with appropriate dopants, it gives rise to the highest ionic conductivities of the family of fluorite oxides, and second, due to the simplicity of defect structure in the very dilute range, it provides a basis for understanding that can be extended to higher concentrations. Most importantly, we have focused on trivalent (M^{3+}) doping which produces relatively high ionic conductivity because one oxygen vacancy (V_O) is introduced for every molecule of M_2O_3. Defect association has then been shown to occur, with the formation of MV_O pairs and leaving an equal number of isolated M^{3+} ions. In spite of the wide range of conductivity obtainable by varying the dopant and its concentration, one of the most striking effects that limits the utilization of such oxides (e.g., for high temperature fuel-cell applications) is the so-called grain-boundary effect. By means of ac measurements over a wide frequency range, we have shown that the effective conductivity (at low frequency, or dc) may fall as much as three orders of magnitude below the true bulk conductivity, due to the presence of an extremely high resistivity layer at

grain boundaries. The effect manifests itself as an extra arc in the ac complex-impedance plots or as a large peak in thermally-stimulated depolarization measurements. The behavior can be interpreted as a classical Maxwell-Wagner 2-layer dielectric.

61679 **(DOE/NASA/0161—10) Cell-module and fuel-conditioner development. Final report, October 1979-January 1982.** Hoover, D.Q. Jr.; Chi, C.V.; Kothmann, R.E. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Feb 1982. Contract AC03-78ET11300. 388p. (NASA-CR—165193). NTIS, PC A17/MF A01. Order Number DE82019982.

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The work described constituted the second phase of a planned program to develop phosphoric acid fuel cell driven on-site integrated energy systems (PAFC-OS/IES). The stack development effort culminated in the design, fabrication and testing of an advanced air cooled 80 cell (8 kW) PAFC stack. The second phase effort on fuel conditioning focused on developing a conceptual design of a reformer for natural gas and acquiring the technical data base needed to design a subsystem suitable for a PAFC-OS/IES. Progress is described in detail on the following four tasks: (1) design of large cell stacks, (2) stack fabrication, (3) stack testing, and (4) fuel conditioner subsystem development. (WHK)

61680 **(NASA-CR—165328) Develop and test fuel cell powered on-site integrated total energy systems. Phase 3: full-scale power plant development.** (Englehard Industries, Edison, NJ (USA)). Jun 1981. 51p. NTIS, PC A04/MF A01.

Progress toward an integrated 5kW power system based upon methanol fuel and a phosphoric acid fuel cell operating at about 473 K is described in detail. Description includes test results of advanced fuel cell catalysts, a semi-automatic acid replenishment system and a completed 5kW methanol/steam reformer. Design features of a 5kW fuel cell stack are included. The results of a preliminary system test on a reformer/stack/inverter combination are reported. An initial design for a 25 kW stack is presented. Experimental plans are outlined for data acquisition necessary for design of a 50 kW methanol/steam reformer. Activities related to complete mathematical modelling of the integrated power system, including wasteheat utilization are described.

61681 **(NASA-CR—165426) Technology development for phosphoric acid fuel cell powerplant, phase 2.** Christner, L. (Energy Research Corp., Danbury, CT (USA)). Dec 1981. 159p. NTIS, PC A08/MF A01.

The development of materials, cell components, and reformers for on site integrated energy systems is described. Progress includes: (1) heat-treatment of 25 sq cm, 350 sq cm and 1200 sq cm cell test hardware was accomplished. Performance of fuel cells is improved by using this material (2) electrochemical and chemical corrosion rates of heat-treated and as-molded graphite/phenolic resin composites in phosphoric acid were determined (3) three cell, 5 in. x 15 in. stacks operated for up to 10,000 hours and 12 in. x 17 in. five cell stacks were tested for 5,000 hours (4) a three cell 5 in. x 15 in. stack with 0.12 mg Pt/sq cm anodes and 0.25 mg Pt/sq cm cathodes was operated for 4,500 hours and (5) an ERC proprietary high bubble pressure matrix, MAT-1, was tested for up to 10,000 hours.

61682 **(NASA-CR—165436) Electrochemical energy storage for an orbiting space station.** Martin, R.E. (United Technologies Corp., South Windsor, CT (USA)). Dec 1981. 61p. NTIS, PC A04/MF A01.

The system weight of a multi hundred kilowatt fuel cell electrolysis cell energy storage system based upon alkaline electrochemical cell technology for use in a future orbiting space station in low Earth orbit (LEO) was studied. Preliminary system conceptual design, fuel cell module performance characteristics, subsystem and system weights, and overall system efficiency are identified. The impact of fuel cell module operating temperature and efficiency upon energy storage system weight is investigated. The weight of an advanced technology system featuring high strength filament wound reactant tanks and a fuel cell module employing lightweight graphite electrolyte reservoir plates is defined.

61683 **(NASA-CR—165455) Develop and test fuel cell powered on-site integrated total energy systems. Phase 3: full-scale power plant development.** (Englehard Industries, Edison, NJ (USA)). Aug 1981. 35p. NTIS, PC A03/MF A01.

A schematic and physical layout is given for the 5kW integrated system and the development status of individual components is described. The results of using a one dimensional mathematical model of the 5kW reformer are presented. Plans for a single-tube reformer test unit for the acquisition of temperature profile data are described. Tentative specifications for a 50kW dc-to-ac inverter are listed. Performance data are given on two 3-cell stacks incorporating semiautomatic acid replenishment systems and improved electrocatalysts. A qualification test on methanol/steam reforming catalyst T2107RS is reported, including a portion in which the catalyst was deliberately poisoned with 800 ppm ethanol in the feed.

61684 **(NASA-CR—165594) Preparation and evaluation of advanced electrocatalysts for phosphoric acid fuel cells.** Stonehart, P.; Baris, J.; Hochmuth, J.; Pagliaro, P. (Stonehart Associates, Inc., Madison, CT (USA)). Dec 1981. 44p. NTIS, PC A03/MF A01.

Two cooperative phenomena are required the development of highly efficient porous electrocatalysts: (1) is an increase in the electrocatalytic activity of the catalyst particle and (2) is the availability of that electrocatalyst particle for the electromechanical reaction. The two processes interact with each other so that improvements in the electrochemical activity must be coupled with improvements in the availability of the electrocatalyst for reaction. Cost effective and highly reactive electrocatalysts were developed. The utilization of the electrocatalyst particles in the porous electrode structures was analyzed. It is shown that a large percentage of the electrocatalyst in anode structures is not utilized. This low utilization translates directly into a noble metal cost penalty for the fuel cell.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 61624, 61672, 62048

3201 Buildings

REFER ALSO TO CITATION(S) 61136, 61144, 61145, 61245, 61636, 61637, 61988

61685 **(BDX—613-2827) Refrigeration production using free cooling.** Rademeyer, J.J. (Bendix Corp., Kansas City, MO (USA)). Aug 1982. Contract AC04-76DP00613. 10p. (CONF-820862—1). NTIS, PC A02/MF A01. Order Number DE82905966.

From Utilities operations seminar; Amarillo, TX, USA (3 Aug 1982).

Bendix operates two boilerhouses to heat and cool approximately 2.5 million ft². The West Boilerhouse has 8 refrigeration machines totaling 9000 tons. The East Boilerhouse has 10 machines totaling 5100 tons. We have begun a program to replace outdated machines and retrofit existing machines to enable them to do free cooling. Free cooling adapts a basic water chiller so it may function as a simple heat exchanger using refrigerant as the working fluid. Whenever condenser water is available at temperatures lower than the desired chilled water temperature, free cooling can provide up to 45% of a chiller's nominal capacity without the operation of its compressor. This will result in substantial energy savings, because the majority of the cost associated with making chilled water is from operation of the compressor. The operation of the free cooling chiller and its performance are discussed. Two 500-ton centrifugal chillers with the free cooling option were installed in the East Boilerhouse in July 1981. During the cold winter months when free chilling was used, a savings of 148,800 kwh of electricity (worth $5609) for compressor operation was achieved. It is estimated that retrofitting four 1000-ton centrifugal chillers for free cooling will have a discounted payback period of 1.1 years. (LCL)

61686 **(BNL—31765) Monitoring of residences with modified oil-heating systems.** Hoppe, R.J.; Graves, W.L. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 31p. (CONF-820849—3). NTIS, PC A03/MF A01. Order Number DE82021753.

From Summer study in energy efficient buildings; Santa Cruz, CA, USA (22 Aug 1982).

An energy conservation study of residential fuel oil savings obtained by the refit of existing boilers and furnaces was made by a one-year field test of 250 detached houses in a 5500 annual heating degree day climate. Retention-head burners properly installed on boilers produced savings of 19%; the addition of vent dampers or boiler temperature programmers to these systems yielded little increase in savings. With boilers using conventional burners, a controls package consisting of a double setback clock thermostat plus a boiler temperature programmer produced fuel savings of 19% in homes unoccupied during the day. With conventional burners the use of vent dampers, flue heat exchangers, or double setback thermostats produced typical savings of 10%. Retention head-burners yielded 11% fuel savings with furnaces. The addition of vent dampers produced no further savings. For use in this project, a low cost method of calculating the annual fuel use in a building was developed that corrected for annual weather changes and for fuel use in heating domestic hot water. The data required were daily mean temperatures and fuel delivery dates and quantities; no instrumentation was installed in the buildings.

61687 **(DOE/CS/20376—T1) Energy usage/consumption analysis for Best Western Kahler Motel, Hibbing, Minnesota.** (Hospitality, Lodging and Travel Research Foundation, New York (USA); Honeywell, Inc., Minneapolis, MN (USA). Technology Strategy Center; Energy Technical Center, San Antonio, TX (USA); Stewart (Sam) and Associates, St. Paul, MN (USA)). Dec 1981. Contract AC02-79CS20376. 114p. NTIS, PC A06/MF A01. Order Number DE82020797.

A detailed analysis is presented of energy consumption and energy use profiles for the Kahler Motel, Hibbing, Minnesota. Data include information collected primarily during the heating and cooling seasons. They show essentially where energy is used, and how much is used and when it is used. Major hotel/motel functions are identified as: guest rooms, public areas, service areas, kitchens, dining areas, laundries, pools, elevators, and other. Energy use is analyzed for each function and in each of the energy use categories, including: space heating, space cooling, domestic hot water, and exterior lighting. (LEW)

61688 **(DOE/CS/20376—T2) Energy usage/consumption analysis for Radisson Atlanta, Atlanta, Georgia.** (Hospitality, Lodging and Travel Research Foundation, New York (USA); Honeywell, Inc., Minneapolis, MN (USA). Technology Strategy Center; Energy Technical Center, San Antonio, TX (USA); Stewart (Sam) and Associates, St. Paul, MN (USA)). Dec 1981. Contract AC02-79CS20376. 145p. NTIS, PC A07/MF A01. Order Number DE82020796.

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A detailed analysis is given of energy consumption and energy use profiles for the Radisson Atlanta, Atlanta, Georgia. Data included were collected primarily during the heating and cooling seasons, and show essentially where energy is used, how much is used, and when it is used. Energy use monitored is analyzed for space heating, space cooling, and domestic hot water. Energy use was measured for guest rooms, public areas, kitchen and service areas, and the laundry. (LEW)

61689 **(DOE/CS/20376—T3) Energy usage/consumption analysis for La Quinta Motor Inn-Airport East, San Antonio, Texas.** (Hospitality, Lodging and Travel Research Foundation, New York (USA); Honeywell, Inc., Minneapolis, MN (USA). Technology Strategy Center; Energy Technical Center, San Antonio, TX (USA); Stewart (Sam) and Associates, St. Paul, MN (USA)). Dec 1981. Contract AC02-79CS20376. 95p. NTIS, PC A05/MF A01. Order Number DE82020792.

Findings are presented based on monitoring energy use at the La Quinta Motor Inn-Airport East. The data was limited by instrument problems. The overall analysis of energy use data monitored at six sites establishes that all have a sizable baseload of energy use regardless of rate occupancy, number of guests, or other activities.

61690 **(DOE/CS/20376—T4) Energy usage/consumption analysis for Radisson Resort and Racquet Club, Scottsdale, Arizona.** (Hospitality, Lodging and Travel Research Foundation, New York (USA); Honeywell, Inc., Minneapolis, MN (USA). Technology Strategy Center; Energy Technical Center, San Antonio, TX (USA); Stewart (Sam) and Associates, St. Paul, MN (USA)). Dec 1981. Contract AC02-79CS20376. 130p. NTIS, PC A07/MF A01. Order Number DE82020793.

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A detailed analysis is given of energy consumption and energy use profiles for the Radisson Resort and Racquet Club. Data were collected during the heating and cooling season and essentially show where energy is used, how much is used and when it is used. Energy uses include space cooling and water heating. Energy use was monitored in the kitchen, guest rooms, dining area, swimming pool, convention area, laundry, elevators, and service/employee areas. (LEW)

61691 **(DOE/CS/20376—T5) Energy usage/consumption analysis for La Quinta Royale, Corpus Christi, Texas.** (Hospitality, Lodging and Travel Research Foundation, New York (USA); Honeywell, Inc., Minneapolis, MN (USA). Technology Strategy Center; Energy Technical Center, San Antonio, TX (USA); Stewart (Sam) and Associates, St. Paul, MN (USA)). Dec 1981. Contract AC02-79CS20376. 94p. NTIS, PC A05/MF A01. Order Number DE82020795.

A detailed analysis is given of energy consumption and energy use profiles for the La Quinta Royale, Corpus Christi, Texas. Data were collected primarily during the heating and cooling seasons and show where energy is used, how much is used, and when it is used. Functional energy use areas are the guest rooms, banquet kitchen, banquet rooms, passenger elevators, ice-maker and soft drink vending machine. Energy use monitored is analyzed in the areas of space heating and space cooling and domestic hot water. (LEW)

61692 **(DOE/CS/20376—T6) Energy usage/consumption analysis for Woodstock Inn, Woodstock, Vermont.** (Hospitality, Lodging and Travel Research Foundation, New York (USA); Honeywell, Inc., Minneapolis, MN (USA). Technology Strategy Center; Energy Technical Center, San Antonio, TX (USA); Stewart (Sam) and Associates, St. Paul, MN (USA)). Dec 1981. Contract AC02-79CS20376. 106p. NTIS, PC A06/MF A01. Order Number DE82020794.

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A detailed analysis is given of energy consumption and energy use profiles for the Woodstock Inn, Woodstock, Vermont. Data were collected primarily during the heating and cooling seasons and show where energy is used, how much is used and when it is used. Energy consumption was measured in the kitchen and guest rooms, and was used for space heating and domestic water heating. (LEW)

61693 **(DOE/CS/62020—T4) Louisiana commercial energy-management workshops: grocery stores.** (Louisiana Dept. of Natural Resources, Baton Rouge (USA)). 1981. Contract FG46-80CS62020. 161p. NTIS, PC A08/MF A01. Order Number DE82019483.

Energy management for grocery stores is discussed, including five steps: performing an energy audit, undertaking a building walk-through survey, developing an understanding of utility rate structures, indentifying and implementing energy conservation opportunities, and maintaining ongoing management and monitoring of the program. Forms and instructions are provided for the building and equipment survey. Energy conservation opportunities include low-cost/no-cost options, retrofits, and some passive solar heating systems. Eight case histories are presented which illustrate the ideas presented. (LEW)

61694 **(DOE/CS/62020—T5) Louisiana commercial energy-management workshops: commercial buildings.** (Louisiana Dept. of Natural Resources, Baton Rouge (USA)). 1981. Contract FG46-80CS62020. 296p. NTIS, PC A13/MF A01. Order Number DE82019338.

Energy management for commercial buildings is discussed in terms of five steps: performing an energy audit, undertaking a building walk-through survey, developing an understanding of utility rate structures, identifying and implementing energy conservation opportunities, and maintaining ongoing management and monitoring of the program. Forms and instructions are provided for the building and equipment survey. Energy conservation opportunities include building operation and maintenance and retrofit projects. Aspects of the building systems are discussed, including the building envelope, lighting, heating, ventilation, air conditioning, refrigeration, domestic water, elevators, food preparation, and laundry. (LEW)

61695 **(DOE/CS/62020—T6) Louisiana commercial energy-management workshops: malls and shopping centers.** (Louisiana Dept. of Natural Resources, Baton Rouge (USA)). 1981. Contract FG46-80CS62020. 293p. NTIS, PC A13/MF A01. Order Number DE82019337.

An energy management program for shopping centers and malls is discussed which includes five steps: performing an energy audit, undertaking a building walk-through survey, developing an understanding of utility rate structures, identifying and implementing energy conservation opportunities, and maintaining ongoing management and monitoring of the program. Forms and instructions are provided for the building and equipment survey. Energy conservation opportunities discussed include building operation and maintenance and retrofit projects. A case history illustrates the points discussed. Building systems discussed one-by-one include the building envelope, lighting, heating, ventilation, air conditioning, domestic water, elevators, and escalators. (LEW)

61696 **(EUR—7133-DE) Energy conservation by use of a gas engine driven heat pump using outside air as heat source.** Heiburg, O. (Commission of the European Communities, Luxembourg. Directorate-General for Research, Science and Education). 1981. 30p. (In German). Commission of the European Communities, Luxembourg.

A monovalent heat pump consisting of a reciprocating gas engine driving a reciprocating compressor supplies a dwelling house with 64 apartments with heat and hot water. Heat capacity is 465 kW at a temperature of -12°C. First the gas engine was fuelled with coke-oven gas contending 57.4% hydrogen and later on the type of gas was changed to natural gas, which has resulted in a longer standing time of the elements of the gas engine. The heat pump system using R22 as refrigerant had a real running time of about 2500 to 3000 hours/year. The installation operated monovalent up to -12°C demonstrated in the frosting period 1978/79. Compared with conventional heating systems the energy conservation is about 50%. Under these conditions the pay back period is less than 10 years.

61697 **(GAO/EMD—82-78) Appliance-efficiency standards: issues needing resolution by DOE.** Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 14 May 1982. 47p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

The National Energy Conservation Policy Act directs the Secretary of Energy to prescribe efficiency standards, or make a no standard determination, for each of 13 major household appliances. DOE began analyses in 1978 and proposed standards for eight appliances. DOE then revised the standards but did not publish them. Additional work was done under the current administration resulting in an April 1982 proposal that no standards be established for appliances. It is concluded that the analytical basis for the April 1982 proposal is questionable and a no standards decision may adversely affect energy conservation and utility load management efforts in many states. Pointed out are the potential viability of proposing standards for certain appliances and indicated that the appliance labeling program for furnaces has limited potential. It is recommended that the Secretary of Energy make no decision on the need for appliance efficiency standards until he considers and resolves the issues raised.

61698 **(LBL—14733) Infiltration and leakage measurements in new houses incorporating energy-efficient features.** Lipschutz, R.D.; Dickinson, J.B.; Diamond, R.C. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 26p. (CONF-820849—5). NTIS, PC A03/MF A01. Order Number DE82020978.

From Summer study in energy efficient buildings; Santa Cruz, CA, USA (22 Aug 1982).

In order to increase energy efficiency in new residential housing, building contractors are using a number of recently developed infiltration-reducing construction techniques. One of these techniques is the installation of a continuous vapor barrier. A second technique is the selective sealing of infiltration sites with polymeric foam caulk following completion of the rough framing of a house. Measurements of leakage areas and infiltration rates in houses incorporating such energy-conserving measures can provide important information about their effectiveness. Houses with energy efficient designs in Eugene, Oregon and Rochester, New York were measured for effective leakage area using blower door fan pressurization. Air exchange rates were determined by tracer gas decay analysis. Fan pressurization measurements were made on 13 new houses in the San Francisco Bay area that had been partially sealed with polymeric foam sealant. A similar group of 13 new houses that had not been sealed were measured as controls. The results of these measurements were used in conjunction with an infiltration model developed at Lawrence Berkeley Laboratory to predict average annual and heating season infiltration rates. Specific leakage areas (leakage area per unit floor area) for the Eugene houses averaged 45% of that measured in post-1975 California housing. The energy-efficient Rochester houses were found to be 50% tighter (in terms of specific leakage area) than their non-energy efficient counterparts in the same area. Excluding leakage in the heating duct system, the average specific leakage area (leakage area per unit floor area) of the houses sealed with polymeric foam was 3.4 cm^3/m^2 (s.d. = 0.7) while the control group averaged 4.2 cm^3/m^2 (s.d. = 1.1), a 19% difference. This difference was found to be statistically significant at the 95% confidence level.

61699 **(LBL—14735) Component leakage testing in residential buildings.** Dickerhoff, D.J.; Grimsrud, D.T.; Lipschutz, R.D. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 19p. (CONF-820849—7). NTIS, PC A02/MF A01. Order Number DE82022055.

From Summer study in energy efficient buildings; Santa Cruz, CA, USA (22 Aug 1982).

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The common approach to leakage area measurements in residential housing is through pressurization of an entire structure with a blower door. However, this technique does not provide quantitative measurements of the leakiness of individual building components. By pressurizing individual components, it is possible to determine the distribution of leakage within a structure. The studies described involved measurement of the leakage areas of fireplaces, bathroom and kitchen exhaust vents, electrical outlets and leakage in the ducts of forced air distribution systems. Component leakage measurements were made in a total of thirty-four houses in Atlanta, Georgia, Reno, Nevada, and the San Francisco Bay area. Damperless fireplaces and ductwork were found to be the most significant sources of leakage in the western houses. In the Atlanta houses, where cooling loads dominate, the significant leakage area was in the ductwork of the distribution system for central air conditioning that passes through the unconditioned space in the attic and crawlspace.

61700 **(N—82-16139) Energy consumption for the Echo Station (DSS 12).** Guiar, C.N.; Schonfeld, D. (Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1981. 9p. NTIS, PC A16/MF A01.

In the telecommunications and data acquisition report, pp. 355-363. See N82-16101.

Energy consumption for the Echo Station is analyzed. The HVAC equipment including vapor compression refrigeration units, absorption chillers, and heating units such as boilers and heat

pumps is shown to be the largest consumer of electrical energy. The energy consumption for the buildings at the station is itemized and compared to the electrical meter data. The figures for energy consumption as predicted by the ECP computer program are found to agree well with the meter data.

61701 **(NP—2906088) Plug in to energy-conservation media materials.** (Florida Dept. of Agriculture and Consumer Services, Tallahassee (USA). Div. of Consumer Services). Jun 1982. 406p. State of Florida Public Commission, Fletcher Building, 101 East Gaines Street, Tallahassee 32301.

This compendium of available energy conservation information is based on survey responses from Florida electric and gas utility companies. For each entry is given the title, source, employee contact, audience, availability, whether or not a sample may be obtained, and whether or not the publication can be reprinted. For radio and television spots there is given the length of the spot and whether or not a script may be obtained. Areas covered include: air conditioning, alternate energy sources, appliances and appliances labeling, catalogs, caulking and weatherstripping, checklists and tips, construction, electricity, energy crisis and shortages, energy saving homes, exhibits and displays, fans and ventilation, fireplaces and wood burning stoves, general information, heating, heat pumps, insulation, lighting, load management, local utility information, mobile homes, natural gas, newsletters, pools, residential conservation service and energy audits, safety, solar, solar water heating, speakers bureau, tax credits and rebates, thermostats, utility bills and meters, waste heat recovery, water heating and conservation, and windows and doors. Participating utility companies and their mailing addresses, as well as other energy resources, are listed. (LEW)

61702 **(NYSERDA—82-21) Residential air leakage and indoor air quality in Rochester, New York.** Offermann, F.J.; Dickinson, J.B.; Fisk, W.J.; Grimsrud, D.T.; Desmond, R.M.; Lints, M.C. (Lawrence Berkeley Lab., CA (USA); Rochester Inst. of Technology, NY (USA)). Jul 1982. Contract W-7405-ENG-48. 107p. NTIS, PC A05/MF A01. Order Number DE82021590.

A sample of 58 occupied homes in Rochester, New York, most of which incorporated special builder-designed weatherization components, were studied to assess (1) the effectiveness of construction techniques designed to reduce air leakage; (2) the indoor air quality and air-exchange rates in selected tight houses; and (3) the impact on indoor air quality of mechanical ventilation systems employing air-to-air heat exchangers. The specific leakage area was measured in each house using the fan pressurization technique. Houses built with polyethylene vapor barriers and joint-sealing were as a group 505 tighter and had a 30% lower overall average heat loss coefficient ($W/^{o}C\text{-}m^{2}$) than a similar group of houses without such components. Mechanical ventilation systems with air-to-air heat exchangers were installed in nine relatively tight houses, some of which had gas stoves and/or tobacco-smoking occupants. Air-exchange rates and indoor concentrations of radon (Rn), formaldehyde (HCHO), nitrogen dioxide (NO_2), and humidity, were measured in each house for one-week periods with and without mechanical ventilation. More detailed measurements including concentrations of carbon monoxide, and inhalable particulates were made in two of these houses by a mobile laboratory. In all nine houses, air-exchange rates were relatively low without mechanical ventilation, 0.2 to 0.5 ach, and yet indoor concentrations of Rn, HCHO, and NO_2 were below existing guidelines. Mechanical ventilation systems were effective in increasing air-exchange rates and in further reducing indoor contaminant concentrations. The average sensible effectiveness of the heat exchangers was 0.65 +- 0.16. It was concluded that when contaminant source strengths are low, acceptable indoor air quality can be compatible with low air-exchange rates.

61703 **(ORNL/TM—8366) Simultaneous heat and mass transfer in absorption of gases in laminar liquid films.** Grossman, G. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 74p. NTIS, PC A05/MF A01. Order Number DE82021108.

A theoretical analysis of the combined heat and mass transfer process taking place in the absorption of a gas or vapor into a laminar liquid film is described. This type of process, which occurs in many gas-liquid systems, often releases only a small amount of heat, making the process almost isothermal. In some cases, however, the heat of absorption is significant and temperature variations cannot be ignored. One example, from which the present study originated, is in absorption heat pumps where mass transfer is produced specifically to generate a temperature change. The model analyzed describes a liquid film that flows over an inclined plane and has its free surface in contact with stagnant vapor. The absorption process at the surface creates nonuniform temperature and concentration profiles in the film, which develop until equilibrium between the liquid and vapor is achieved. The energy and diffusion equations are solved simultaneously to give the temperature and concentration variations at the interface and the wall. Two cases of interest are considered: constant-temperature and adiabatic walls. The Nusselt and Sherwood numbers are expressed in terms of the operating parameters, from which heat and mass transfer coefficients can be determined. The Nusselt and Sherwood numbers are found to depend on the Peclet and Lewis numbers as well as on the equilibrium characteristics of the working materials.

61704 **(PB—82-186453) Thermal behavior of buildings and the role of computers in energy conservation.** Oliver, P.P. (National Building Research Inst., Pretoria (South Africa)). 1981. 21p. NTIS, PC A02/MF A01.

The interrelationship between the climate, building design and energy consumption are considered and, the use of the digital computer to evaluate the potential of different energy conservation measures in buildings is discussed.

61705 **(PB—82-203662) Residential energy conservation and price response.** Ogus, M.R. (Economic Research Service, Washington, DC (USA). Economic Development Div.). Mar 1982. 28p. NTIS, PC A03/MF A01.

This paper examines the factors affecting the quantity of home heating fuel used and compares the willingness of consumers of natural gas (NG) and liquified petroleum gas (LPG) to adjust to very different changes in their heating costs over similar periods of time. LPG households made more and bigger temporary changes than did NG households and were more persistent in maintaining their behavior. LPG households also made structural improvements to the heat resistance of their homes while few NG households did so. Although people can adjust their fuel-use habits, a substantial economic incentive is required to create a significant and sustained response.

61706 **(PNL—4329) Analysis of changes in residential energy consumption, 1973-1980.** King, M.J.; Belzer, D.B.; Callaway, J.M.; Adams, R.C. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1982. Contract AC06-76RL01830. 31p. NTIS, PC A03/MF A01. Order Number DE83000383.

The progress of energy conservation in the residential sector since the 1973 to 1974 Arab oil embargo is assessed. To accomplish this goal, the reduction in residential energy use per household since 1973 is disaggregated into six possible factors. The factors considered were: (1) building shell efficiencies, (2) geographic distribution of households, (3) appliance efficiency, (4) size of dwelling units, (5) fuel switching, and (6) consumer attitudes. The most important factor identified was improved building shell efficiency, although the impact of appliance efficiency is growing rapidly. Due to data limitations, PNL was not able to quantify the effects of two factors (size of dwelling units and fuel switching) within the framework of this study. The total amount of the energy reduction explained ranged from 18 to 46% over the years 1974 to 1980.

61707 **(SERI/TP—254-1652) Daylight and daylighting laboratory at the Solar Energy Research Institute.** Robbins, C.; Hunter, K. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1982. Contract AC02-77CH00178. 6p. (CONF-820928—1). NTIS, PC A02/MF A01. Order Number DE82019255.

From International passive and low-energy alternatives conference; Bermuda, Bermuda (5 Sep 1982).

Presented is an overview of the research activities and facilities of the Daylighting Laboratory at the Solar Energy Research Institute (SERI). In the SERI Laboratory, daylighting theory is studied with respect to the particular daylight conditions in the United States, and experiments are performed on the integration of daylighting with other passive and conventional energy strategies for heating, cooling, and lighting buildings.

61708 **(SERI/TP—254-1673) Predicting energy savings attributed to daylighting.** Robbins, C.L. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1982. Contract AC02-77CH00178. 11p. (CONF-820928—3). NTIS, PC A02/MF A01. Order Number DE82022038.

From International passive and low-energy alternatives conference; Bermuda, Bermuda (5 Sep 1982).

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A method is described for estimating a building's energy savings attributed to daylighting by predicting the percentage of the year that the electric lighting system is not in use. This depends on the particular control strategy chosen, a standard work year, and the amount of light [as a daylight factor (DF)] reaching on daylight and sunlight availability for selected cities in the United States.

61709 **Household demand for home heating.** Krumm, R.J. (Univ. of Chicago, IL). *Resources and Energy;* 4: No. 2, 121-144(Jun 1982).

The net benefits of alternative home-heating services. The costs associated with a particular system/fuel alternative can be calculated to determine the relative benefits of alternatives. Using individual household data, empirical analysis of system and fuel adoption in newly constructed housing units indicates that fuel price differences and household-demand characteristics play major roles in the decision process, and that system and fuel choice are not independent. The results suggest that estimates of fuel-and-system adoption patterns based on aggregate data are incomplete and likely to be misleading in the projection of future trends. 4 references, 5 figures, 4 tables.

61710 **Indoor climate, outdoor climate and energy consumption: a new approach to the calculation of the effect of the outdoor and indoor climate on the energy consumption in buildings based on methods of statistical analysis.** Vanpaassen, A.H.C. Delft, Netherlands; Technische Hogeschool (Oct 1981). 131p.

The calculation efficiency of the yearly energy consumption of HVAC systems is improved by improving the calculation method and by developing compact models of the building's thermal behavior and of the outdoor climate. Emphasis is on modeling the outdoor climate. The thermal behavior of the building is the combined effect of the solar radiation, the outdoor temperature, the energy sources and sinks within the building and the thermal behavior of the structure. It is characterized with the response factor method. With this method an exitation variable (for example the solar radiation) and the variable of interest (the indoor temperature or the cooling load) are related by a series of response factors. An experimental validation is given based on measurements of the indoor- and outdoor climate of a specific room in an excisting building. Also measurements are done on a 'climate room', which is specially designed to check these response factors.

61711 **Energy conservation ideas for lighting systems.** Harrold, R.M. *American Institute of Industrial Engineers, Detroit Chapter, Proceedings of the Annual Conference;* 73-80(1981). (CONF-810538—). Detroit, MI, USA (17 May 1981).

Calculation procedures for establishing power limits for lighting systems are described. Details of a survey, or audit of spaces in a building, which provide background data for determining in which areas energy may be saved, are presented. Evaluation points examined are lighting needs, equipment efficiency, use of daylighting controls, maintenance procedures, and operating schedules.

61712 **(PB—82-189564) Earth-covered buildings: an exploratory analysis for hazard and energy performance. Final report Sep 79-Nov 81.** Moreland, F.L. (Moreland Associates, Fort Worth, TX (USA)). [nd]. 314p. (MA—1-81). NTIS, PC A14/MF A01.

The performance of earth-covered buildings is examined regarding storms, nuclear detonations, earthquakes, fire, nuclear radiation, energy consumption, compatibility with solar energy systems, peak-load effects, soil and groundwater effects, air and climate effects, occupant evaluation, and resource management. Potential longterm benefits are assessed, including the areas of economic benefits, community benefits, and security benefits.

61713 **(NP—2904414) Energy efficiency for architectural drafting instructors.** Scharmann, L. (ed.). (Nebraska Energy Office, Lincoln (USA)). [nd]. 35p. NTIS, PC A03/MF A01. Order Number DE82904414.

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This curriculum guide contains five units that were designed to be incorporated into an existing program of Architectural Drafting. Energy Conservation Awareness presents an overview of residential energy use and audit procedures. Residential Energy Consumption provides information on space heating, ventilating, air conditioning, hot water heating, lighting, and appliances. Design Considerations for Residential Energy Efficiency deals with site orientation, building type, room arrangement, location of openings, and building codes. Residential Construction Practices and Materials includes building and insulating materials, construction methods, infiltration, vapor barriers, and moisture control. Energy Saving Devices and Methods covers familiarization with ventilation, lighting, solar systems, stoves and fireplaces, wind generators, heat sinks, moveable insulation, etc.

3202 Transportation

REFER ALSO TO CITATION(S) 60826, 61496, 61613, 61637

61714 **(ANL/CNSV—28) Baseline projections of transportation energy consumption by mode: 1981 update.** Millar, M.; Bunch, J.; Vyas, A.; Kaplan, M.; Knorr, R.; Mendiratta, V.; Saricks, C. (Argonne National Lab., IL (USA)). Apr 1982. Contract W-31-109-ENG-38. 175p. NTIS, PC A08/MF A01. Order Number DE82021145.

A comprehensive set of activity and energy-demand projections for each of the major transportation modes and submodes is presented. Projections are developed for a business-as-usual scenario, which provides a benchmark for assessing the effects of potential conservation strategies. This baseline scenario assumes a continuation of present trends, including fuel-efficiency improvements likely to result from current efforts of vehicle manufacturers. Because of anticipated changes in fuel efficiency, fuel price, modal shifts, and a lower-than-historic rate of economic growth, projected growth rates in transportation activity and energy consumption depart from historic patterns. The text discusses the factors responsible for this departure, documents the assumptions and methodologies used to develop the modal projections, and compares the projections with other efforts.

61715 **(FHWA/TX—82/24-225-24) Evaluation of High-Occupancy-Vehicle projects in the HEEM.** Memmott, J.L.; Buffington, J.L. (Texas Transportation Inst., College Station (USA)). Jan 1982. 95p. (TTI—2-8-77-225-24). NTIS, PC A05/MF A01. Order Number DE82906165.

The increasing importance of improving the efficiency of transportation facilities has resulted in a need for a systematic economic model to evaluate High Occupancy Vehicle (HOV) projects. These projects encourage higher vehicle occupancy rates by restricting the use of some portion of the facility to some vehicle types or minimum number of occupants. The feasibility is examined of using the Texas Highway Economic Evaluation Model (HEEM) to evaluate HOV projects. Three major deficiencies are examined: limited variety of highway types, assumptions in the model, and method of allocating corridor traffic to specific routes within the corridor. Additional highway types are recommended to evaluate

HOV projects, along with parameter specifications for those highway types. Changes in the assumptions of the model include percent trucks, the occupancy rates, value of time, and future vehicle demand. The allocation of corridor traffic is an important aspect of evaluating HOV projects as well as other types of highway projects. An alternative allocation method is presented which is based upon minimized total user costs. This method results in corridor allocation such that the marginal user costs for each route in the corridor are equal. User cost functions are derived, based upon the user cost calculations in the HEEM, which can be used to allocate corridor traffic for any number of routes within the corridor. Recommended programming changes to the HEEM are presented to implement HOV analyses. This includes the marginal cost allocation method, and recommended values for the assumptions in the model as they relate to HOV projects.

61716 **(GAO/PLRD—82-64) DOD can save millions by using energy efficient centralized aircraft support systems.** (General Accounting Office, Washington, DC (USA). Procurement, Logistics, and Readiness Div.). 7 May 1982. 53p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

Report to the Secretary of Defense.

The ways the Department of Defense can save millions of dollars annually by using new energy efficient centralized aircraft support systems at certain Air Force and Navy bases are discussed. The Air Force and Navy have developed and installed several different systems and have realized some degree of success. However, each service has developed its systems independently. Consequently, there is no commonality between the services' systems which could permit economical procurements for standard servicewide systems. Standardization would also prevent duplication of design efforts by the services and minimize proliferation of aircraft support equipment. It also would allow the services to further reduce costs by combining requirements to assure the most economical quantities for buying system components. GAO makes specific recommendations to the Secretaries of Defense and the Air Force to develop standard systems and to install them at all bases where feasible and practical.

61717 **(NP—2906077) Projected energy demand for the rail-freight-transportation sector for Nebraska. Projections energy report, Number 61.** Macke, D.W. (Nebraska State Government, Lincoln (USA)). 15 Oct 1980. 74p. NTIS (US Sales Only). Order Number DE82906077.

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Rail freight traffic is expected to significantly increase during the next decade and possibly the remainder of this century in Nebraska. The primary cause of this rapid increase in traffic is probably attributable to increased use of coal and consequently increasing pass-through and shipments. Energy consumption related to rail freight traffic is projected to at least double from 1980 to 1990 and possibly increase substantially more. Such increases in consumption are expected to occur even with projected modal efficiencies taken into account.

61718 **(NP—2906078) Projected energy demand for the passenger-transportation sector for Nebraska. Projection energy report No. 60.** Macke, D.W. (Nebraska Legislative Research Office, Lincoln (USA)). 23 Sep 1980. 31p. NTIS, PC A03/MF A01. Order Number DE82906078.

Portions of document are illegible.

Passenger transportation is highly dependent upon portable fuels, particularly gasoline. Passenger travel, both within and between Nebraska cities, is nearly totally reliant upon the automobile as the travel mode. These two facts are not projected to change during the forecasting period (1980 to 2000). In all projections, consumption is expected to decline for the state. In the high projection, it is assumed that personal miles traveled and the state's population will increase in a substantial fashion. In the moderate projection, it is assumed that personal miles traveled will remain constant over time and the state's population will increase slightly. In the low projection, it is assumed that personal miles will decrease substantially and the state's population will increase slightly initially and begin to decline during the 1990's. In all cases it is assumed that US Department of Transportation motor vehicle fleet efficiencies averages will be obtained. The critical determinant resulting in the total consumption decline in all cases is the ever improving motor vehicle fleet efficiencies created by federally mandated minimum efficiency standards for new motor vehicles. The forecasting methodology is simple and well documented. Fundamental changes in trends associated with any of the independent variables could alter the estimated consumption levels significantly.

61719 **(PB—82-188517) Relationship between urban growth and energy consumption to public transportation.** (Transportoekonomisk Inst. (Transport Economy Inst.), Oslo (Norway)). Dec 1981. 32p. NTIS, PC A03/MF A01.

The relationship between urban growth and energy consumption to public transport is analyzed. The main emphasis is put upon daily travel in urban areas. Recommendations are made on how different urban functions should be located and developed to minimize the energy consumption for daily travels.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 60795, 61091, 61100, 61101, 61630, 61633, 61634, 61751, 62113

61720 **(DOE/CS/40040—5) Intermediate- and high-temperature flue-gas recuperators for a variety of industrial-process environments. Project 61006 final report.** Stanton, E.H.; Larson, D.H.; Gawlowski, T.C.; Paul, L.F. (Institute of Gas Technology, Chicago, IL (USA)). Dec 1981. Contract AC07-77CS40040. 177p. NTIS, PC A09/MF A01. Order Number DE82022029.

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An industrial recuperator design that uses reradiant heat transfer to achieve improved recovery efficiency was field-evaluated. Modifications were made to an aluminum remelting furnace. Average fuel savings for the recuperated mode was 31%. The internal rate of return for the cash flows calculated for the recuperators with and without the reradiant insert were, respectively, 46.0% and 41.6%.

61721 **(DOE/CS/40191—T1) Energy conservation in the canning industry. Phase II: measurement of energy used in unit operations.** (National Food Processors Association, Berkeley, CA (USA); California Univ., Davis (USA)). Dec 1981. Contract AC07-78CS40191. 391p. NTIS, PC A17/MF A01. Order Number DE82020768.

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Presented are results obtained from the monitoring of energy intensive unit operations used in the food industry. Data were collected over a two-year period. Energy intensive unit operations were isolated, then complete energy and product mass balances were obtained. Operations which were monitored included a variety of retorts, blanchers, evaporators, hot break heaters and caustic peelers. Thermal energy was found to be the most significant part of the total energy used in processing foods. Modifications to existing equipment and pilot scale experiments illustrated means of improving use of energy. Major factors contributing towards inefficient use of thermal energy were determined. Information, via a questionnaire to the industry, provided data on the numbers of energy intensive unit operations, hours of operation, quantity of product processed through the operations and geographic distribution. Suggestions for the improvement of the use of energy have been made.

61722 **(DOE/CS/40210—T1) uv radiation curable paints. Topical report on material identification.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 13 Jan 1981. Contract AC01-79CS40210. 6p. NTIS, PC A02/MF A01. Order Number DE81011194.

The program for the development of ultraviolet radiation curing of paints for application on preformed structures is discussed. The starting point of this program was the matching of resins, photoinitiators, and pigments which will result in coatings that can be cured by ultraviolet radiation. The initial work was the identification of reactive diluents and base resins that are sensitive to the uv curing process. The reactive monomeric diluents tested included multifunctional acrylates, monofunctional acrylates, and

non-acrylic unsaturated esters. The end point will be the application of these coatings to prefabricated metal structures to demonstrate the viability of this technique in producing commercially acceptable painted products. These uv curable paints should produce films that are hard, adherent, and opaque at a nominal thickness of one mil (0.001 inch).

61723 **(DOE/CS/40312—1) Development of retrofitting modifications of textile-loom picking-and-lay mechanisms for reduction of energy consumption. Final report (Phase I).** (Lowell Univ., MA (USA)). Jul 1982. Contract AC02-80CS40312. 58p. NTIS, PC A04/MF A01. Order Number DE82020948.

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Air jet looms are more energy efficient than conventional shuttle looms and can be run at higher speeds. But before any loom can be installed in a particular building, it is important to know the level of the dynamic loads which will be transmitted to the foundation. Described is a reliable technique for measuring the dynamic loads, and compares the loads of an air jet loom with the loads of a conventional shuttle loom. Test results show that the peak dynamic loads of the air jet loom are closely comparable to the loads of the shuttle loom. The test techniques attempt to measure the maximum dynamic load that the loom is capable of developing. Test experience shows that the actual loom loads depend to a minor degree on the state of the loom itself, and to a significant degree on the boundary (mounting) conditions. In particular, slippage at the loom mounting interface limits the dynamic load to the friction force. Since slippage was absent in the vertical direction, the actual vertical loads are nearly maximum. However, slippage was present in the horizontal direction, and the actual horizontal loads are less than the maximum possible loads.

61724 **(DOE/R5/10251—T1) Low-cost process-heat recovery. Final report.** Theisen, P.; McCray, J. (Theisen (Phillip), Madison, WI (USA); McCray (James), Madison, WI (USA)). 26 May 1982. Contract FG02-80R510251. 24p. D. Order Number DE82016652.

Portions of document are illegible.

Heat recovery systems developed specifically for use with gas-fired ovens such as those used in restaurants and bakeries are found to be a viable energy saving option for reducing operating expenses. The objectives of the work reported were: to assess waste heat recovery potential, perform an economic analysis, design heat exchanger and system, and develop an integrated computer program. The first three objectives were successfully met for flat plate and plate fin air-to-air heat recovery systems. A user friendly, interactive computer program was developed for heat recovery systems using the FORTRAN language. An economic analysis program was also developed. (LEW)

61725 **(DOE/RA/50297—T1) Feasibility study of utilization of degummed soybean oil as a substitute for diesel fuel. Final report.** (Gold Kist, Inc., Decatur, AL (USA). Decatur Soy Div.). Nov 1981. Contract FG07-80RA50297. 285p. NTIS, PC A13/MF A01. Order Number DE82020534.

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The purpose of this project was to determine the economic and technological feasibility of producing a diesel oil substitute or extender from soybean oil. Existing technology was reviewed, to determine the minimum modification necessary for production of an acceptable fuel product. Current methods of oil extraction and refining were considered, as well as the products of those processes. The information developed indicated that the degummed soybean oil produced by existing processing plants is theoretically suitable for use as a diesel fuel extender. No modification of process design or equipment is required. This situation is very favorable to early commercialization of degummed soybean oil as a diesel fuel extender during the 1980's. Moreover, a large energy gain is realized when the soybean oil is utilized as fuel. Its heat of combustion is reported as 16,920 Btu per pound, or 130,000 Btu per gallon. Production of soybean oil consumes between 3000 and 5000 Btu per pound or 23,000 and 39,000 Btu per gallon. A resource availability study disclosed that the southeastern region of the United States produces approximately 260 million bushels of soybeans per year. In the same general area, fourteen extraction plants are operating, with a combined annual capacity of approximately 200 million bushels. Thus, regional production is sufficient to support the extraction capacity. Using an average figure of 1.5 gallons of oil per bushel of soybeans gives annual regional oil production of approximately 300 million gallons.

61726 **(ENEA-RT-EC—82-1) Substitution between production factors a translog sectoral model.** Rinaldi, A.I. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Direzione Centrale Studi dell'Energia Nucleare e delle Energie Alternative (ENEA)). 1982. 150p. (In Italian). NTIS (US Sales Only), PC A07/MF A01. Order Number DE82906297.

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The paper describes a methodology for the analysis of the substitution between several inputs in production. The factor substitution theory is outlined; the characteristics of translog production and cost functions are examined. Finally, an econometric estimate of inter-energy substitution for several sectors of Italian manufacturing is presented.

61727 **(EPRI-EM—2573-Vol.1-Exec.Summ.) Evaluation of industrial advanced heat recovery/thermal energy storage systems. Final report.** McChesney, H.R.; Bass, R.W.; Landerman, A.M.; Obee, T.N.; Sgamboti, C.T. (United Technologies Research Center, East Hartford, CT (USA)). Sep 1982. 66p. NTIS, PC A04/MF A01. Order Number DE82906475.

The recovery of waste heat from industrial processes offers significant opportunity for energy conservation provided the available energy source can be matched with a compatible energy-consuming sink or end-use process. This investigation has involved: examining plant and process energy data acquired during on-site visits to 12 industrial plants from which 24 candidate applications were identified where thermal energy storage (TES) would be necessary either to make possible or to enhance the recovery and reuse of industrial waste heat; compiling cost and performance data for commercially available (1985) equipment to recover, store, and transfer waste heat between source and sink processes on demand; and assessing the economic benefits, possible energy savings, and utility impact if proposed systems were installed and operated in industrial plants. The executive summary, presented in Volume 1, summarizes the work performed and the results achieved.

61728 **(EUR—7006-DE) Heat recovery units with 'reflux heat pipes' as thermal components.** Groll, M.; Nguyen-Chi, H.; Kraehling, H. (Commission of the European Communities, Luxembourg. Directorate-General for Research, Science and Education). 1981. 130p. (In German). Commission of the European Communities, Luxembourg.

Gravity-assisted heat pipes and two-phase thermosyphons ('reflux heat pipes') are excellent thermal components for heat recovery units. These units have a great energy savings potential. With respect to an economic manufacture and in order to achieve a broader application for these heat recovery units the following important research and development tasks have been tackled: (i) Systematic investigation of the heat transfer and fluid-mechanic phenomena in gravity-supported heat pipes and thermosyphons and of their performance limitations. The aim of these investigations is to generate correlations which allow to design the components; (ii) investigation of the long-term compatibility of structural materials and working fluids and determination of the long-term operational behavior. This is a necessary basis for a reliable long-term operation of the components.

61729 **(EUR—7061-DE) Heat recovery from waste water through energy-saving heat pump systems.** Flohrschuetz, R.; Hau, E.; Wiedmann, U. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Muenchen (Germany, F.R.)). 1981. 179p. (In German). Commission of the European Communities, Directorate-General for Information Market and Innovation, Jean Monnet Building, Luxembourg.

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A description is given of apparatus, experimental results and discussion of studies undertaken on heat recovery from sewage water, industrial waste, the use of waste water as heat sources for

heat pumps, heat transport, heat exchange for insertion in waste water, heat pumps and compressors, general design of heat pumps, processing and utilization of separation materials. Tabulated data are given on energy utilization in the Federal Republic of Germany, chemical composition of waste water, operation and location of German sewage works, heat production and consumption, and cost of heat production. 115 references.

61730 **(EUR—7387-DE) Technical and scientific possibilities of waste heat utilization in aluminum production.** Kipping, W. (Vereinigte Aluminium-Werke A.G., Luenen (Germany, F.R.)). 1981. 135p. (In German). Euorpean Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037.

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A study is made of the energy balance in production equipment at the Consolidated Aluminum Works Luenen/Westfalen in various stages of production such as pipe-joint, calcine roasting, the power plant, evaporation, and smelting shops. The energy balance is illustrated by Sankey diagrams. Superior heat recovery plants or compound systems were not found to be economical at the present time. Energy is accordingly found to be economized only through the optimization of individual processes. 20 references, 44 figures, 20 tables.

61731 (P—500-82-005, pp 6-17) **Municipal cogeneration.** Gandara, A.; Park, S.L. Jan 1982. NTIS, PC A04/MF A01.

In Cogeneration in municipalities. Workshop proceedings for local governments and municipal utilities.

The energy situation, cogeneration systems, cogeneration potential, advantages of cogeneration, the California Energy Commission projects, issues in development, and the reasons cities should be interested are reviewed.

61732 (P—500-82-005, pp 18-31) **California air quality regulations for cogeneration projects.** Amar, P. Jan 1982. NTIS, PC A04/MF A01.

In Cogeneration in municipalities. Workshop proceedings for local governments and municipal utilities.

The following regulatory concerns are discussed: regulatory jurisdiction, permit procedures, new pollution source review, best available control technology, permit application-authority to construct, and permit to operate.

61733 **(PB—82-181769) Energy conservation in the pulp and paper industry - a development study.** Wojtowicz, W.S.; Venter, J.S.M. (National Timber Research Inst., Pretoria (South Africa)). Dec 1980. 54p. NTIS, PC A04/MF A01.

Literature on energy conservation in the pulp and paper industry was studied with the objective of becoming abreast of relevant developments and identify further avenues of research. Energy conservation measures will require an incresing amount of attention and energy awareness should be promoted among personnel by a continued effort of management. Potential areas of energy conservation and the principles involved are discussed and the role of a research institute in an energy conservation program is outlined.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 61630, 61631, 61632, 61670, 61731, 61732

61734 **(DOE/CS/24312—4) Questions and answers about energy recovery from waste.** (One America, Inc., Washington, DC). Sep 1982. Contract AC01-80CS24312. 29p. NTIS, PC A03/MF A01. Order Number DE82022154.

Questions and answers about the developing waste-to-energy industry are presented. They are intended as a ready reference for the general public and others interested in exploring the option of utilizing municipal waste as a renewable energy resource. Questions have been researched and answered in six broad categories: (1) General Information; (2) State-of-the-Art; (3) Economics/Financial; (4) Environmental; (5) Institutional; and (6) Project Implementation.

61735 **(EGG—2193) Municipal-solid-waste bioconversion technologies.** Leeper, S.A.; Wolfram, J.H.; Chow, M.L.; Dawley, L.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1982. Contract AC07-76ID01570. 74p. NTIS, PC A04/MF A01. Order Number DE83000263.

In the bioconversion approach municipal solid waste (MSW) is a resource from which methane, ethanol, and chemicals can be produced by anaerobic digestion and fermentation. In addition, the quantity and volume of MSW requiring disposal are reduced and stabilized. The relevant literature (as of January 1982) has been surveyed and is reviewed. The availability, composition, and properties of MSW are reported. Pretreatment of lignocellulosic material, the predominant component of MSW, is described and discussed, including mechanical (separation and size reduction), chemical (acid hydrolysis, enzymatic hydrolysis, caustic treatment, and other chemical treatment), and physical (thermomechanical/hydropulping and irradiation) processes.

61736 **(HRP—0904134/4) An energy management program for public health service recipients of financial assistance. Final report.** Bruce, R.G.; Lupton, C.H.; Lichter, N. (Granville Corp., Washington, DC (USA)). Feb 1982. 112p. NTIS, PC A06/MF A01.

An evaluability assessment (EA) is an analytical study that determines if a program possesses (or can possess) characteristics which enable evaluation of its impacts and outcomes. The purpose of this EA is to document the critical elements of this energy management program, including the objectives of the program, the assumptions and expectations on which it is based, and the activities necessary for its implementation. In addition, problems associated with the program are identified.

61737 **(NP—2903984) Local energy initiatives: a second look. A survey of cities and counties, California 1981.** Tomasi, T. (California State Office of Appropriate Technology, Sacramento (USA)). 1981. 127p. NTIS, PC A07/MF A01. Order Number DE82903984.

The survey results document momentum at the local level to reduce energy costs and boost reliance on alternative, renewable energy sources. California cities and counties have designed and implemented cost-effective, environmentally sound energy practices in internal management and resource development, and in the fields of planning, land use, transportation, and education. Examples are given of the use of alternative technologies to make future energy secure and protect the economic and environmetnal well-being of California communities.

61738 **(PB—82-207630) Work zone safety, maintenance management and equipment, and transportation of hazardous materials. Transportation research record.** Faulkner, M.J.S. (Transportation Research Board, Washington, DC (USA)). 1981. 49p. NTIS, PC A03/MF A01.

Contents of this report are: Field evaluation of Highway Advisory Radio For traffic management in work zones; Use of chevron patterns on traffic control devices in work zones; Effectiveness of city traffic-control programs for construction and maintenance work zones; Concrete barriers at transition zones adjacent to two-way traffic operation on normally divided highways; Alternative sign sequences for work zones on rural highways; Highway-related tort claims to Iowa counties; Procedure for evaluating efficiency of power-operated cutting tools in localized pavement repair; Portable hydrodynamic brine roadway deicer system; Crash testing of a portable energy-absorbing system for highway service vehicles; Regulation of the movement of hazardous cargoes on highways.

61739 **Energy and other resource conservation within urbanization areas.** Rowe, P.G. (Rice Univ., Houston, TX). *Environmental Management;* 6: No. 3, 231-240(May 1982).

The study area was the proposed "downtown" of The Woodlands, a new town north of Houston, Texas. Two plans were developed for this area. In one, no particular attempt was made to conserve energy (conventional plan), while in the other, energy conservation was a primary consideration (conservation plan). For both plans, estimates were made of energy consumption within buildings, in the transportation sector, and in the actual production

of building materials themselves (embodied energy). In addition, economic and environmental analyses were perfomed, including investigation of other resource issues such as water supply, solid waste disposal, stormwater management, and atmospheric emissions. Alternative on-site power systems were also investigated. Within the bounds of economic feasibility and development practicality, it was found that application of energy-conserving methods could yield annual energy savings of as much as 23%, and reduce dependence on prime fuels by 30%. Adverse economic effects on consumers were found to be minimal and environmental quality could be sustained. The major institutional constraints appeared to be those associated with traditional property ownership and with the use of common property resources. The resistance to change of everyday practices in land development and building industries also seemed to constrain potential applications.

61740 **Cogeneration and small power production: state implementation of Section 210 of PURPA.** Lock, R.H.J.H.; Van Kuiken, J.C. *Solar Law Reporter;* 3: No. 4, 659-701(Nov 1981).

State public utility commissions (PUCs) are required by Section 210 of the Public Utility Regulatory Policies Act of 1978 (PURPA) to implement rules promulgated by the Federal Energy Regulatory Commission (FERC) governing the purchase of electric power by utilities from qualifying cogeneration and small power production facilities (QF's). Some states have completed their initial implementation obligations; most are still in the implementation stage. Most states initially concentrated on setting rates for purchases of power from smaller QF's. These rates will act as an early price signal for QF development, particularly important to smaller QF's needing to persuade financial backers of the adequacy of revenue streams, and will provide a useful experience base for future dealings with larger QF's. The common issues and problems emerging from these early state implementation proceedings are reviewed, compared, and commented upon.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 61496

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 61749

61741 **(AD-A—114096/1) 1980 crc fuel rating program: road octane performance in 1980 model cars.** (Coordinating Research Council, Inc., Atlanta, GA (USA)). Jul 1981. 194p. NTIS PC MF A01.

Full-Throttle Modified Uniontown Road Octane Numbers (Road ON) were obtained by twelve participating laboratories in thirty-seven cars that represent twenty-four different 1980 makes and models, one 1979 model, and one 1981 model. Part-throttle Road ON ratings were obtained by four participating laboratories in twelve cars representing nine different 1980 makes and models. The data were analyzed using multiple linear regression and analysis of variance techniques. Analyses were made on all-car average data, as well as data from individual cars and from several subgroups. The all-car data did not show a significant ethanol-content effect, but eight of the thirty-seven cars did show significant effects. Analysis of variance showed that fuels had the largest effect on full-throttle Road ON. Cars had smaller, but highly significant, effects. The effects of fuels on Road ON varied among the cars.

61742 **(NASA-CR—165130) Advanced Gas Turbine (AGT) powertrain system initial development report.** (Ford Motor Co., Dearborn, MI (USA); AiResearch Mfg. Co., Phoenix, AZ (USA)). Aug 1980. 150p. NTIS, PC A07/MF A01.

The powertrain consists of a single shaft regenerated gas turbine engine utilizing ceramic hot section components, coupled to a slit differential gearbox with an available variable stator torque converter and an available Ford intergral overdrive four-speed automatic transmission. Predicted fuel economy using gasoline fuel over the combined federal driving cycle (CFDC) is 15.3 km/1, which represents a 59% improvement over the spark-ignition-powered baseline vehicle. Using DF2 fuel, CFDC mileage estimates are 17.43 km/1. Zero to 96.6 km/hr acceleration time is 11.9 seconds with a four-second accleration distance of 21.0 m. The ceramic radial turbine rotor is discussed along with the control system for the powertrain.

61743 **(NASA-CR—165175) Advanced gas turbine (AGT) powertrain system development for automotive applications.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). Nov 1980. 431p. NTIS, PC A19/MF A01.

Progress in the development of a gas turbine engine to improve fuel economy, reduce gaseous emissions and particulate levels, and compatible with a variety of alternate fuels is reported. The powertrain is designated AGT101 and consists of a regenerated single shaft gas turbine engine, a split differential gearbox and a Ford Automatic Overdrive production transmission. The powertrain is controlled by an electronic digital microprocessor and associated actuators, instrumentation, and sensors. Standard automotive accessories are driven by engine power provided by an accessory pad on the gearbox. Component/subsystem development progress is reported in the following areas: compressor, turbine, combustion system, regenerator, gearbox/transmission, structures, ceramic components, foil gas bearing, bearings and seals, rotor dynamics, and controls and accessories.

61744 **Economic comparisons of solar and fossil total energy systems for industrial applications.** Pine, G.D. (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *American Society of Mechanical Engineers, [Paper];* No. 79-WA/TS-6, 1-8(1979). (CONF-791205—). Contract W-7405-ENG-26.

From ASME winter annual meeting; New York, NY, USA (2 Dec 1979).

Four industrial application case studies were completed comparing fuel cell, diesel, and solar central receiver total energy systems with boiler and grid-electric systems. All total energy systems save significant quantities of fuel compared with separate supply of electricity and heat. However, the fuel cell and diesel systems require natural gas and oil, respectively, and while using less total fuel, they may substitute the use of these fuels for more plentiful coal or uranium. Solar total energy systems, on the other hand, reduce not only total fuel consumption, but also the oil and gas consumption. Solar systems are relatively capital intensive, but show significant economies of scale. They were found to compete well with the other systems in sizes larger than two to three MWe, but not so well for smaller sizes.

3302 External Combustion Engines

61745 **(RDA-TR—118700-004) Concept evaluation of automotive propulsion using liquid air/nitrogen. Task V report.** Dooley, J.L.; Hammond, R.P. (R and D Associates, Marina del Rey, CA (USA)). Jul 1982. Contract AC01-81ER30011. 12p. NTIS, PC A02/MF A01. Order Number DE82019168.

Two alternative programs for developing a vehicle to demonstrate the performance of an automotive propulsion system using liquid air or nitrogen in a Rankine cycle engine are described. Program A is a two-stage development in which the initial stage is an examination in depth of the most critical areas of concept components without undertaking confirmatory hardware testing and development. The second stage would continue the work with bench testing, complete component hardware development, and construction and testing of an instrumented roadable test vehicle and a demonstration vehicle. Program B is a coordinated, interactive analysis, design and development course that results in a driveable demonstration vehicle in the shortest time and at the lowest cost. It permits many low-cost bench tests to verify design details early in the program. Operation of larger components can be done soon enough to get maximum feedback and interaction into the system design. The first two-stage program is justifiable and expedient in a period when adequate development funds are currently unavailable but may become available at a later date, while the alternative coordi-

nated program is the more expeditious pathway to the goal of a successful demonstration of the concept.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 61590, 61594

61746 **(ANL/OEPM—81-13) Research, development, and demonstration of nickel-iron batteries for electric-vehicle propulsion. Annual report for 1981.** Broglio, E.P. (Eagle-Picher Industries, Inc., Joplin, MO (USA)). Mar 1982. Contract W-31-109-ENG-38. 42p. NTIS, PC A03/MF A01. Order Number DE82021266.

The objective of this program is to develop a nickel-iron battery system suitable for use in the propulsion of electric and electric/hybrid vehicles. The Near-Term Electric Vehicle Battery Development goals are: battery capacity of 25 to 30 kWh; specific energy (C/3 rate) of 60 Wh/kg; specific power of 100 W/Kg (peak) and 20 W/Kg (sustained); duty cycle of 2 to 4 hr for discharge and 4 to 8 hr for charge; energy efficiency of >60%; cost of $70/kWh (1977); and cycle life (80% DOD) of 2000 cycles. The program as conducted in FY 1981 continued to show marked progress in reaching the above referenced goals. The FY 1981 program concentrated upon the fabrication, characterization and testing of the required electrodes together with the assembly and testing of full-scale cells and 6 volt (270 Ah) modules. The FY 1981 program was structured to advance the technical aspects of the nickel-iron program while simultaneously reducing its potential future cost in both the materials and process areas. Initial full-size electrodes reached 2300 cycles, full-scale, 270 Ah cells exceeded 800 cycles, and five-cell, 6 volt modules reached 725 cycles during the reporting period. All tests are presently on-going. Based on the fade rate experienced to date, lifetime of the initial electrodes is expected to be 2500 cycles.

61747 **(DOE/CS/51518—1) Electric and hybrid vehicle project. Quarterly report of private-sector operations, first quarter 1982.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Transportation Consulting Div.). 1 Jun 1982. Contract AC08-77CS51518. 41p. NTIS, PC A03/MF A01. Order Number DE82021006.

Portions of document are illegible.

As of January 1, 1982 sixteen private-sector site operators at 30 sites in the US were involved in electric and hybrid electric-powered vehicle demonstration programs. Data for 1981 and the first quarter of 1982 are presented on vehicle selection, miles accumulated, energy usage, maintenance requirements, reliability and operating performance for demonstration vehicles at each site. (LCL)

61748 **(NASA-CR—165536) Hybrid and electric advanced vehicle systems (heavy) simulation. Final report.** Hammond, R.A.; McGehee, R.K. (Boeing Computer Services Co., Tukwila, WA (USA)). Nov 1981. 89p. NTIS, PC A05/MF A01.

A computer program to simulate hybrid and electric advanced vehicle systems (HEAVY) is described. It is intended for use early in the design process: concept evaluation, alternative comparison, preliminary design, control and management strategy development, component sizing, and sensitivity studies. It allows the designer to quickly, conveniently, and economically predict the performance of a proposed drive train. The user defines the system to be simulated using a library of predefined component models that may be connected to represent a wide variety of propulsion systems. The development of three models are discussed as examples.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 61747

3307 Emission Control

61749 **(AD-A—112473/4) In-cylinder sampling of hydrocarbons in a Texaco l-141 TCP engine. Final report 1978-1981.** Ingham, M.C.; Myers, P.S.; Uyehara, O.A. (Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering). 20 Feb 1982. 8p. NTIS, PC A02/MF A01.

A technique was developed to obtain time- and spatially-resolved gas samples from the development volume of a reciprocating engine. The technique was used to investgate the distribution of fuel and products of combustion, with emphasis on the sources and formation mechanisms of gaseous hydrocarbons, in a single cylinder -141 TCP engine. A mathematical model predicted the actual sample gas origin, relative to the instantaneous sampling orifice position, as a function of the local gas motion and properties. Samples were taken at times ranging from 30 deg CA BTDC to 60 deg CA ATDC. Gas chromatography gave the sample composition, including the concentration versus carbon number distribution of the hydrocarbons. Local stoichiometry, local reactant hydrogen/carbon ratio and apparent local particulate concentration were also calculated. Significant vertical stratification persists in the L-141 TCP combustion chamber as late as 60 deg CA ATDC, indicating that mixing in the vertical direction in the central part of the chamber is inhibited by solid body rotation of the gases. Exhaust hydrocarbons consisted primarily of heptane, probably originating from the bowl surface, and species having two carbon atoms. Total hydrocarbons and the relative proportion of heptane to C2 species decreased with increasing load, because of the higher gas temperatures.

61750 **Effects of filter loading and filter type on the mutagenicity and composition of diesel exhaust particulate extracts.** Gorse, R.A. Jr. (Ford Motor Co., Dearborn, MI); Salmeen, I.T.; Clark, C.R. *Atmospheric Environment;* **16**: No. 6, 1523-1528(1982).

Diesel vehicle exhaust particles were simultaneously collected from a dilution tube on three commonly used types of filters. Sampling was performed over single cycles and over 7 or 10 cycles of the 1974 Hot-start Federal Test Procedure (FTP/H). Particulate loadings on the filters ranged from 48 to 660 $\mu g\ cm^{-2}$. The filters were extracted with dichloromethane and the extracts were characterized by the Ames Salmonella-histidine reversion assay (strains TA98 and TA100, without microsomal activation) and by high performance liquid chromatography (HPLC) with fluorescence detection. It was found that the extracts from lightly loaded filters of the three types were indistinguishable. A similar conclusion obtains for the heavily loaded filters, confirming our results from an earlier study. The percentage of extractable material in the particulate matter, the fluorescent intensities of two of the for HPLC fractions and the Ames assay activities (revertants per μg of extract) each increase linearly with particulate loading on the filters. We attribute these increases to reactions between the particle-bound organic material and reactive gases in the exhaust stream.

3308 Alternative Fuels

61751 **(DOE/CS/50025—2) Alcohol as a fuel for farm and construction equipment.** Borman, G.L.; Foster, D.E.; Meyers, P.S.; Uyehara, O.A. (Wisconsin Univ., Madison (USA)). Jun 1982. Contract AC02-79CS50025. 33p. NTIS, PC A03/MF A01. Order Number DE82021022.

Work in three areas dealing with the utilization of ethanol as fuel for farm and construction diesels is summarized. The first part is a review of what is known about the retrofitting of diesels for use of ethanol and the combustion problems involved. The second part is a discussion of the work that has been done under the contract on the performance of a single-cylinder, open-chamber diesel using solutions and emulsions of diesel fuel with ethanol. Data taken include performance, emissions and cylinder pressure-time for diesel fuel with zero to forty percent ethanol by volume. Analysis of the data includes calculation of heat release rates using a single zone model. The third part is a discussion of work done retrofitting a multicylinder turbocharged farm tractor diesel to use ethanol by

fumigation. Three methods of ethanol introduction are discussed; spraying ethanol upstream and downstream of the compressor and prevaporization of the ethanol. Data on performance and emissions are given for the last two methods. A three zone heat release model is described and results from the model are given. A correlation of the ignition delay using prevaporized ethanol fumigation data is also given. Comparisons are made between fumigation in DI and IDI engines.

61752 **(PB—82-199035) Assessment of research and development needs for methane fueled engine systems. Final report Aug 81-Mar 82.** Joyce, T.J. (Joyce (T.) Associates, Inc., Fairfax, VA (USA)). Mar 1982. 185p. NTIS, PC A09/MF A01.

The most significant technical, economic and institutional problems which have limited the use of natural gas as a fuel for stationary and mobile engines were identified and a research and development plan which would, if successful, resolve them was prepared. Problem identification was carried out through a mail canvass of equipment suppliers, vehicle operators, gas utilities and government organizations plus personal interviews with a number of the respondents. Current and planned research and development programs to develop improved equipment for use of compressed natural gas (CNG) and liquefied natural gas (LNG) as a vehicle fuel were reviewed.

61753 **(NP—2906162) Cost-sharing the establishment of methanol-refueling facilities.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). [nd]. 5p. NTIS, PC A02/MF A01. Order Number DE82906162.

This Contract Opportunity Notice is proposed to identify organizations and firms capable and interested in cost-sharing the initial establishment of a statewide methanol fuel distribution system in California to service existing methanol fleet vehicles and the addition of 1000 methanol vehicles pending approval of a proposed budget appropriation. If approved, money to purchase these vehicles and to install commercial refueling stations would be available in July 1982 and vehicles would be in service by the spring of 1983. The proposed program would appropriate $5 million from the Energy and Resources Fund (ERF).

36 MATERIALS

REFER ALSO TO CITATION(S) 60712, 61672

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 60765, 61198, 61242, 61309, 61312, 61331, 61878, 61896, 62097, 62252, 62380

61754 **(BNL—31776) Electrochemical aspects of stress-corrosion crack growth.** Newman, R.C.; Sieradzki, K. (Brookhaven National Lab., Upton, NY (USA)). Jun 1982. Contract AC02-76CH00016. 30p. (CONF-8206115—1). NTIS, PC A03/MF A01. Order Number DE82021543.

From 6. Canadian fracture conference on time dependent fracture of engineering materials - environmental effects; Harrison Hot Springs, B.C, Canada (17 Jun 1982).

Some contributions of electrochemical methods to the understanding of stress-corrosion cracking are described, with examples drawn from studies of stainless steels, nickel alloys and brasses. Considerations related to the local alloy composition, solution composition and electrode potential within a crack are classified and illustrated. The relationship between electrochemical and acoustic noise is discussed.

61755 **(CISE—1693) Dynamic elastic-plastic characterization of nuclear pressure vessel material.** Angelino, G.; Fossati, C. (Centro Informazioni Studi Esperienze, Milan (Italy)). 1981. 12p. (CONF-810373—). NTIS, PC A02/MF A01.

From 5. international conference on fracture; Cannes, France (29 Mar 1981).

A test and instrumentation, which both extend the Charpy specimen performances, are introduced. Ability of the test to predict material parameters is demonstrated.

61756 **(CONF-810831—98-Draft) Fission-fusion correlations for swelling and microstructure in stainless steels: effect of the helium-to-displacement-per-atom ratio.** Odette, G.R.; Maziaz, P.J.; Spitznagel, J.A. (California Univ., Santa Barbara (USA); Oak Ridge National Lab., TN (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 1981. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01. Order Number DE82020938.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Portions of document are illegible.

The initial irradiated structural materials data base for fusion applications will be developed in fission reactors. Hence, this data may need to be adjusted using physically-based procedures to represent behavior in fusion environments, viz. - fission-fusion correlations. Such correlation should reflect a sound mechanistic understanding, and be verified in facilities which most closely simulate fusion conditions. In this paper we review the effects of only one of a number of potentially significant damage variables, the helium to displacement per atom ratio, on microstructural evolution in austenitic stainless steels. Dual-ion and helium preinjection data are analyzed to provide mechanistic guidance; these results appear to be qualitatively consistent with a more detailed comparison made between fast (EBR-II) and mixed (HFIR) spectrum neutron data for a single heat of 20% cold-worked 316 stainless steel. These two fission environments bound fusion (He/dpa ratios. A model calibrated to the fission reactor data is used to extrapolate to fusion conditions. Both the theory and broad empirical observation suggest that helium to dpa ratios have both a qualitative and quantitative influence on microstructural evolution; and that the very high and low ratios found in HFIR and EBR-II may not result in behavior which brackets intermediate fusion conditions.

61757 **(CONF-810856—5) Characterization of TiB_2-Ni ceramics by transmission and analytical electron microscopy.** Sklad, P.S.; Yust, C.S. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01. Order Number DE82020915.

From International conference on the science of hard materials; Moran, WY, USA (23 Aug 1981).

A series of TiB_2-Ni ceramics fabricated using different TiB_2 powders have been examined. It has been determined that the amount of intergranular phase observed decreases as the mean particle size of the TiB_2 decreases, the excess initial nickel content being exuded from the compacts during hot pressing. Both conventional electron microscopy; and AEM techniques have been used to identify the primary intergranular phase in the hot-pressed TiB_2-Ni composites. X-ray microanalysis showed that the phase contained nickel and titanium, with Ni:Ti $>$ 20. Convergent beam electron diffraction as well as selected area diffraction established that the crystal structure was orthorhombic.

61758 **(CONF-820808—2) Influence of traces of Sb and Zr on creep and creep fracture of Ni-20% Cr.** Schneibel, J.H.; White, C.L.; Padgett, R.A. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE82020914.

From 6. international conference on the strength of metals and alloys; Melbourne, Australia (16 Aug 1982).

The creep and creep fracture behavior of a Ni-20% Cr, a Ni-20% Cr-0.15% Sb and a Ni-20% Cr-0.11% Zr alloy are compared. Whereas Sb does not change the behavior of Ni-20% Cr, the addition of Zr leads to a pronounced reduction in the creep rate and a strong increase in the creep ductility. Analytical Electron Microscopy and Auger Analysis suggest that the segregation of S to the grain boundaries is reduced in the Zr-doped alloys. Diffusional creep data show that Zr slows down the grain boundary diffusivity in Ni-Cr. These experimental findings explain qualitatively why Ni-Cr-Zr fractures in a ductile manner and does not cavitate intergranularly.

61759 (CONF-820808—3) Small angle neutron scattering study of creep deformation and fracture of Type 304 stainless steel. Yoo, M.H.; Ogle, J.C.; Schneibel, J.H.; Swindeman, R.W. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01. Order Number DE82020899.

From 6. international conference on the strength of metals and alloys; Melbourne, Australia (16 Aug 1982).

A small-angle neutron scattering (SANS) study has been performed to determine the size distribution of carbide precipitates that were formed during creep deformation in Type 304 stainless steel. The hardening mechanism during primary creep by a fine dispersion of carbide particles in the matrix was confirmed by the SANS measurement and also by direct TEM observations. The size distribution of creep-induced cavities was also determined by SANS measurements after post-creep solution heat treatment.

61760 (CONF-820846—2) Application of quantitative EELS to analysis of the titanium-carbide phase in austenitic stainless steels. Maziasz, P.J.; Zaluzec, N.J. (Oak Ridge National Lab., TN (USA); Argonne National Lab., IL (USA)). 1982. Contract W-7405-ENG-26. 2p. NTIS, PC A02/MF A01. Order Number DE82020931.

From 10. international congress on electron microscopy; Hamburg, F.R. Germany (17 Aug 1982).

Portions of document are illegible.

The intent of this work is to study the light element (C,N,O) contents, particularly C, of individual particles of the titanium MC carbide phase. Analytical electron microscopy (AEM) studies can employ either electron energy loss spectroscopy (EELS) or x-ray energy dispersive spectroscopy (XEDS) with ultra-thin window detectors to detect these elements, but we will show that because MC contains substantial Mo and C, the former method is best. The alloy studied is, in wt %, a 14 Cr/16 Ni/0.25 Ti modification of normal Type 316 austenitic stainless steel. This alloy is the first generation Prime Candidate Alloy (PCA) of its alloy class for the Alloy Development for Irradiation Performance (ADIP) task of the Magnetic Fusion Energy (MFE) program, and the microstructure studied was designed for scoping the resistance of this material to fusion irradiation. The key to this application is stability of the MC phase, and composition is very important to stability. However, such studies cannot be undertaken without the advanced techniques and equipment development of EELS and we will focus on the interfacing of the latter with the metallurgical system studied.

61761 (DEMO—81/13) Study of the concentration of certain inorganic air pollutants in the city of Elefsis. Katselis, V.; Paradellis, T. (Democritus Nuclear Research Center, Athens (Greece)). Nov 1981. 12p. NTIS (US Sales Only), PC A02/MF A01; Also available from Library, Democritus NRC. Order Number DE82702537.

The airborne concentration of Ca, Fe, Zn, Mn, Pb and Br pollutants has been measured in the city of Elefsis during 1977. The results obtained are compared with data obtained during 1975 in the same site, as well as with data obtained from the site of the NRC Democritus during 1977.

61762 (DOE/ER/02029—T3) Acoustic emission signature analysis. Technical progress report, 1 July 1980-30 June 1982. Pardee, W.J. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Jun 1982. Contract AC03-78ER02029. 39p. NTIS, PC A03/MF A01. Order Number DE82017192.

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This program's purpose is to establish a scientific basis for the interpretation of acoustic emission signals in terms of the properties of the source event. Model sources have been used to produce emissions from a variety of chemically well-characterized sources. These signals have been analyzed and signatures identified. All measurements have been done with a single transducer. New digital data acquisition equipment (two Data Precision Data 6000, two thermal A/D converters and signal processors) were purchased, but their high frequency modules (20 MHz) are six months late in delivery, so critical experimental tasks related to multi-position detection have not been completed. A six month no-cost extension has been requested to permit completion of this work. Two papers have been published this year, one other submitted for publication, and a fourth is in preparation. A patent disclosure has been submitted.

61763 (DOE/ER/10566—T1) Synthesis of metastable A-15 superconducting compounds by ion implantation and electron-beam annealing. Technical progress report. Clapp, M.T. (Massachusetts Univ., Amherst (USA). Dept. of Mechanical Engineering). 1982. Contract AC02-80ER10566. 16p. NTIS, PC A02/MF A01. Order Number DE82021627.

The effects are studied of high-dose implantation of B and C into Nb_3Al alloys. This particular system was chosen because of its superconducting properties. Nb_3Al has a-high superconducting transition temperature T/sub c/ of 18 K and has the A-15 structure. Most high T/sub c/ materials seem to involve metastable materials and in particular metastable A-15's. There is empirical speculation that as the B atom in the A_3B A-15 structure decreases in size, the transition temperature increased. This increase in T/sub c/ appears to be associated with a decrease in lattice parameter and a rapprochement of the Nb atoms. A attempt is made to gradually replace the Al atoms by the smaller B and C atoms. Normal alloying of B and C with Nb_3Al will make the A-15 structure unstable. Ion implantation of B and C is a good approach for attempting to synthesize metastable A-15 Nb_3Al/sub 1-x/B/sub x/ and Nb_3Al/sub 1-x/C/sub x/ (x = 0 to 1).

61764 (DOE/ET/52023—27) Simulating the CTR environment in the HVEM. Progress report, October 1, 1981-June 30, 1982. Jesser, W.A. (Virginia Univ., Charlottesville (USA)). 1982. Contract AS05-76ET52023. 39p. NTIS, PC A03/MF A01. Order Number DE82021222.

Portions of document are illegible.

Neutron radiation effects on the tensile properties of Type 316 stainless steel are described.

61765 (JINR—R-14-81-564) Study on hyperfine magnetic fields on samarium impurity atoms in cobalt. Budzynski, M.; Kochetov, O.I.; Lyatushinski, A.; Khazratov, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1981. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702694.

The investigation of hyperfine magnetic fields on samarium impurity nuclei in ferromagnetic matrices is continued. In particular, the influence of annealing temperature on the effective magnetic field affecting the ^{153}Sm nuclei in the cobalt matrix is investigated. Implanted samples (implanted ions dose not exceeding 10^{12} ion/cm^2) of $^{152}SmCo$ have been annealed at the t deg=200, 400 and 600 deg C in vacuum of 10^{-6} torr. The method of integral perturbed angular correlations (IPAC) of the 868-244 keV cascade has been used. The values of hyperfine magnetic field and f parameter characterizing the number of nuclei undergoing the hyperfine field effect are presented. With the annealing temperature increase the value of the field (or f) is decreased. On the basis of data obtained and already available the following conclusions are drawn: radiation induced defects strongly affect the IPAC results, defects evolution depends on the t deg of annealing which is bound to impurity ions migration and impurity-vacancy clusters formation, the hyperfine magnetic fields ratio is equal to that of the corresponding magnetic moments of the matrix.

61766 (LBL—14612) Analysis of iron fluorescence from vacuum-ultraviolet photolysis of iron pentacarbonyl. Horak, D.V. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 176p. NTIS, PC A09/MF A01. Order Number DE82020975.

Thesis.

A quantitative study of the fluorescence and photoionization yields from the vuv photolysis of $Fe(CO)_5$ in a semi-effusive beam was carried out and compared favorably with a limited degree of freedom statistical dissociation model over the 10 to 14 eV range of excitation energies. At 1170 A the branching ratio between fluorescence and neutral production was computed to be 1.33 x 10^{-4}, and the branching ratio between ionization and neutral production was determined to lie between 0.0048 and 0.0024. The absorption cross-section at 1170 A was measured to be 1.3 +- 0.2 A^2. The cross-section for neutral production was 1.3 +- 0.2 A^2; for ionization, be-

tween 0.006 and 0.003 A^{-2}; and for fluorescence, 1.7 +- 0.3 x 10^{-4} A^{-2}. By comparing experimental data to the model, the total metal-ligand bond dissociation energy of $Fe(CO)_5$ was determined to be 6.10 +- 0.05 eV.

61767 **(PNL—4266) Feasibility of using a high-level waste canister as an engineered barrier in disposal.** Slate, S.C.; Pitman, S.G.; Nesbitt, J.F.; Partain, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1982. Contract AC06-76RL01830. 54p. NTIS, PC A04/MF A01. Order Number DE82021361.

The objective of this report is to evaluate the feasibility of designing a process canister that could also serve as a barrier canister. To do this a general set of performance criteria is assumed and several metal alloys having a high probability of demonstrating high corrosion resistance under repository conditions are evaluated in a qualitative design assessment. This assessment encompasses canister manufacture, the glass-filling process, interim storage, transportation, and to a limited extent, disposal in a repository. A series of scoping tests were carried out on two titanium alloys and Inconel 625 to determine if the high temperature inherent in the glass-fill processing would seriously affect either the strength or corrosion resistance of these metals. This is a process-related concern unique to the barrier canister concept. The material properties were affected by the heat treatments which simulated both the joule-heated glass melter process (titanium alloys and Inconel 625) and the in-can melter (ICM) process (Inconel 625). However, changes in the material properties were generally within 20% of the original specimens. Accelerated corrosion testing of the heat treated coupons in a highly oxygenated brine showed basic corrosion resistance of titanium grade 12 and Inconel 625 to compare favorably with that of the untreated coupons. The titanium grade 2 coupons experienced severe corrosion pitting. These corrosion tests were of a scoping nature and suitable primarily for the detection of gross sensitivity to the heat treatment inherent in the glass-fill process. They are only suggstive of repository performance since the tests do not adequately model the wide range of repository conditions that could conceivably occur.

61768 **(SAND—82-8668) Variations in weld ferrite content due to P and S.** Brooks, J.A.; Thompson, A.W.; Williams, J.C. (Sandia National Labs., Albuquerque, NM (USA); Case Western Reserve Univ., Cleveland, OH (USA). Div. of Metallurgy and Materials Science). Apr 1982. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01. Order Number DE82015879.

It was found that additions of P and S can have a considerable effect on the amount of weld ferrite in Fe-Ni-Cr austenitic alloys. These impurities significantly increased the ferrite content of welds containing primarily the lathy ferrite morphology, but slightly decreased the ferrite content of welds containing regions of primary austenite solidification. The reduction in ferrite is explained in terms of Cr-enriched inclusions decreasing the Cr equivalent and ferrite content. In an alloy with welds containing skeletal ferrite, in which the ferrite-austenite transformation is also important, S slightly decreased the measured ferrite content while P slightly increased it. It was concluded that reduced interphase boundary mobility resulted from P and S during the solid-state diffusion-controlled transformation of ferrite-austenite. This decreased boundary mobility resulted in a reduction of the extent to which austenite consumed the ferrite, which increased the ferrite content especially in the lathy ferrite morphology of primary ferrite solidified welds.

61769 **Au diffusion in amorphous and polycrystalline Ni/sub 0.55/ Nb/sub 0.45/.** Doyle, B.L.; Peercy, P.S.; Wiley, J.D.; Perepezko, J.H.; Nordman, J.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **53**: No. 9, 6186-6190(Sep 1982). Contract AC04-76DP00789.

Diffusion of Au in amorphous and polycrystalline Ni/sub 0.55/ Nb/sub 0.45/ has been studied by Rutherford backscattering spectroscopy of heat-treated Au/NiNb couples. The diffusion process is characterized by interdiffusion of Nb and Au with NiNb showing a Au miscibility of ~20 at. %. The Au diffusion coefficient in polycrystalline NiNb at 400 °C was found to be 1.6 x 10^{-15} cm^2/s. The diffusion coefficient for Au in amorphous NiNb was found to be substantially less, ~10^{-21} cm^2/s at 400 °C. These results support the concept of using amorphous films as metallizations or diffusion barriers in high-temperature solid-state device applications.

61770 **Resonant photoemission study of UNi/sub 5-x/ Cu/sub x/.** Schneider, W.; Reihl, B.; Martensson, N.; Arko, A.J. (Institut fuer Atom- und Festkoerperphysik, Freie Universitaet Berlin, D-1000 Berlin 33, Germany). *Physical Review [Section] B: Condensed Matter;* **26**: No. 1, 423-426(1 Jul 1982).

Valence-band spectra of the intermetallic compounds UNi/sub 5-x/Cu/sub x/ (x = 0.0, 2.5, and 5) have been measured using synchrotron radiation in the energy range 10 to 130 eV. In all compounds the 5f-derived valence-band density of states is pinned to the Fermi energy. In contrast to earlier work, no splitting of the U 5f emission due to different final-state 5f configurations is observed in UCu_5. This points towards an itinerant description of the 5f electrons in these compounds. A decrease in the intensity of the Ni two-hole satellite is observed in going from Ni metal and UNi_5 to $U(Ni/sub\ 0.5/Cu/sub\ 0.5/)_5$ which can be related to a filling of the Ni d band. Furthermore, a shift of the Ni satellite energy by 1.3 eV towards higher binding energies occurs in $U(Ni/sub\ 0.5/Cu/sub\ 0.5/)_5$.

61771 **Presence and absence of magnetism in thin Ni films.** Tersoff, J.; Falicov, L.M. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **26**: No. 1, 459-461(1 Jul 1982).

We calculate the magnetization of Ni films, with thicknesses from one to four atomic layers, on Cu(100) and Cu(111) substrates. The substrate acts to suppress the Ni magnetization; on Cu(111) only, results are consistent with a magnetically "dead" monolayer Ni film. The effect of substrate composition and orientation on film magnetization is discussed. We thus explain disparate experimental results.

61772 **Refractory-metal stabilized amorphous stainless steel.** Brimhall, J.L.; Charlot, L.A.; Kissinger, H.E. (Pacific Northwest Lab., Richland, WA (USA)). *Journal of Materials Science;* **17**: No. 4, 1149-1155(Apr 1982).

Concurrent heavy ion irradiation during annealing lowered the normal crystallization temperature and altered the type of crystallization reaction in an amorphous 304 stainless steel containing 14 at% tungsten. The crystallization temperature was lower by approximately 150 K during irradiation and only a fine grained chi phase was formed during irradiation compared to the dual structure of bcc + chi phase formed in the absence of irradiation. The decrease in the crystallization temperature was attributed to radiation enhanced diffusion and the preferential formation of the chi phase was attributed to localized rearrangement of the amorphous structure due to displacement spikes.

61773 **Angular distributions of 250 GeV/c positive particles axially channeled in germanium crystal. Pt. 3. Channeling and blocking.** Sun, C.R.; Gibson, W.M.; Kim, I.J.; Williams, G.O. (State Univ. of New York, Albany (USA)); Carrigan, R.A. Jr.; Chrisman, B.L.; Toohig, T.E. (Fermi National Accelerator Lab., Batavia, IL (USA)); Guzik, Z.; Nigmanov, T.S.; Tsyganov, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 125-128(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Channeling phenomena are observed for charged particles of momentum up to 250 GeV/c in a germanium crystal. The angular distributions of the channeled particles are compared with theoretical predictions based on a diffusion model. The results indicate additional mechanisms leading to dechanneling of the particles although channeling effects are observed for particles incident at up to several times the critical angle, in contrast with the results from low energy channeling.

61774 **Surface roughness factor measurements of 304 and 316 stainless steels with helium ion irradiation.** Maeda, S.; Mohri, M.; Hashiba, M.; Yamashina, T. (Hokkaido Univ., Sapporo (Japan). Dept. of Nuclear Engineering); Kaminsky, M. (Argonne National Lab., IL (USA)). *Journal of Nuclear Materials;* **103**: No. 1-3, 445-450(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

A comparison of the surface roughness factor (SRF), determined by xenon adsorption, has been made for the surfaces of 304 and 316 stainless steels irradiated with 100 keV helium ions. The variation of the SRF value was measured as a function of ion dose. Topological changes of the irradiated surfaces were determined by scanning electron microscopy (SEM). The SRF values were found to increase with increasing ion dose on both of the specimens. The unirradiated surface has SRF values of 2.7 and 1.9 for 304 SS and 316 SS, respectively. After the irradiation to a dose of 0.2 C/cm^2 and 0.5 C/cm^2 at room temperature, SRF increased to 25.6 and 28.1, respectively, on 304 SS, and 7.8 and 14.7, respectively, on 316 SS. SEM photographs revealed that the surfaces were heavily damaged by blistering and flaking for these ion doses, but differently for the two specimens. The average blister diameter observed on the irradiated 304 SS specimen was found to be about three times larger than that observed on the 316 SS specimen. The average number of exfoliated surface layers was about 3.5 for 304 SS, while it was 15 for 316 SS for the identical ion dose of 0.5 C/cm^2. The differences in the SRF values observed on the two materials can be explained by the size and density of blisters and flakes, and the number of ruptured blister skins sticking to the surface.

61775 **High-energy-neutron damage in Nb_3Sn. Changes in critical properties, and damage-energy analysis.** Snead, C.L. Jr. (Brookhaven National Lab., Upton, NY (USA)); Parkin, D.M. (Los Alamos National Lab., NM (USA)); Guinan, M.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Journal of Nuclear Materials;* **103**: No. 1-3, 749-754(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Filamentary wires of Nb_3Sn have been irradiated with fission-reactor, 14.8-MeV, and d-Be neutrons and the changes in critical properties measured. The changes observed scale reasonably well with the calculated damage energies for the irradiations. A critical dose for operation of these conductors in fusion-magnet applications is determined to be 0.19 eV/atom damage energy or 0.0019 dpa.

61776 **Fast diffusion and electrotransport of cobalt, iron and nickel in α-Y.** Okafor, I.C.I.; Carlson, O.N. (Ames Lab., IA (USA)). *Journal of the Less-Common Metals;* **84**: No. 1, 65-72(Mar 1982).

The diffusion and electrotransport properties of cobalt, iron and nickel in α-Y were determined. Measurements over the temperature range 1290-1600 K showed that all three solutes have high mobilities and that the diffusivities are of the order of 10^{-5} - 10^{-6} cm^2 s^{-1}. Plots of lnD versus 1/T for each solute at several different temperatures gave activation energies for diffusion between 80 and 97 kJ mol^{-1}. Negative values were obtained for the effective valence of each solute.

61777 **Superconductivity of $Th(Ir,Os)_2$ and $Th(Ir,Ru)_2$ alloys.** Houghton, J.S.; Dewees, M.; Lawson, A.C. (Pomona Coll., Claremont, CA (USA)); Smith, J.L. (Los Alamos Scientific Lab., NM (USA)). *Journal of the Less-Common Metals;* **83**: No. 2, L47-L49(Feb 1982).

As part of a continuing series of investigations concerning the nature of the C15 compound $ThOs_2$, the authors have examined superconductive behavior in the pseudobinary system $Th(Ir,Os)_2$ and, for comparison, $Th(Ir,Ru)_2$. Superconducting transition temperatures and lattice constants for $Th(Ir,Os)_2$ and $Th(Ir,Ru)_2$ are presented.

61778 **Stress corrosion cracking of Inconel 600 in high-temperature water.** van Rooyen, D.; Brady, R. (BNL, Upton, NY 11973). *Transactions of the American Nuclear Society;* **39**: 447(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

61779 **Superconducting transition under pressure in some eutectic alloys.** Razavi, F.S.; Schilling, J.S. (Bochum Univ. (Germany, F.R.). Inst. fuer Experimentalphysik). pp 397-399 of Physics of solids under high pressure. Proceedings of the international symposium held at Bad Honnef, Germany, F.R., August 10-14, 1981. Schilling, J.S. (Bochum Univ. (Germany, F.R.)); Shelton, R.N. (Iowa State Univ. of Science and Technology, Ames (USA)) (eds.). Amsterdam, Netherlands; North-Holland (1981).

From Conference on high pressure physics; Bad Honnef, F.R. Germany (Aug 1981).

The superconducting transition temperatures Tsub(c) of Irsub(.79)Ysub(.21) and Irsub(.8)Eusub(.2) eutectic alloys were measured under pressure up to 3.5 GPa hydrostatically. The results show negative slopes of -20 mK/GPa for the Tsub(c). These results are compared with the theoretical model of Suhl et al. The Tsub(c) of Irsub(.79)Ysub(.21) was also measured quasihydrostatically up to 13 GPa. Several explanations of the experimental results are discussed.

61780 **(ORNL-tr—4873) Metallographic studies of the surface layer of alloys after electrochemical dimensional treatment.** Smolentsev, V.P.; Khairutoinov, A.K.; Oleinichenko, T.F.; Kobeleva, T.K. Translated from *Fizika i Khimiya Obrabotki Materialov ;* **1**: 135-137(1971). Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE82021017.

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This article presents results from metallographic studies of the surface layer of hardened steels 4OKhNMA, OKhNZMFA, and the alloys ABT1 and VTZ-1 following electrochemical dimensional treatment under conditions used to prepare channels for measuring machines. Recommendations are presented for using electrochemical dimensional treatment as a finishing operation and for selecting machine allowances for further treatment. This article presents results from metallographic studies of the surface layer of 4OKhNMA and OKhNZMFA steels hardened to HRC35-37, the aluminum alloy AVT1 and the titanium alloy VTZ-1 after electrochemical dimensional treatment under conditions used in the production of channels in measuring machines.

61781 **(ORNL-tr—4871) Influence of temperature and forced convection on anode dissolution of titanium alloy VT-3.** Kornilov, E.N.; Sedykin, F.V.; Kholpanov, L.P. Translated from *Fizika i Khimiya Obrabotki Materialov ;* **5**: 68-74(1968). Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE82021020.

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The properties of titanium, such as the ability to be passivated readily and its chemical stability, which are useful in many applications, also make it difficult to use electrochemical methods for processing titanium. To increase the rate of the anode dissolution of titanium, it is necessary to increase the voltage in the electrochemical cell and the temperature of the electrolyte. In this connection, it is extremely important to find the optimum electrolyte composition, making it possible to reduce considerably the anode polarization and, consequently, the amount of energy used in the process. This report presents results from experimental studies on the influence of temperature, the electrolyte composition, the pH value, and the amount of mixing on the rate of anode dissolution. The temperature kinetic method was used to evaluate the data obtained.

61782 **(CONF-810831—95) Tensile properties of 20% cold-worked titanium-modified type 316 stainless steel irradiated in HFIR.** Grossbeck, M.L.; Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE82020906.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

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An alloy of type 316 stainless steel with the addition of 0.23% Ti (316 + Ti) has been irradiated in the 20% cold-worked condition in the HFIR (a mixed fast and thermal neutron spectrum

reactor) and tested near the irradiation temperature in the range of 300 to 600°C. Tensile tests were performed following irradiation to fluence levels of 0.63 to 2.1 x 10^{26} n/m² (E > 0.1 MeV) and helium levels of 200 to 1000 at. ppM. The 316 + Ti exhibited higher strength and lower ductility than similarly irradiated type 316 stainless steel (316 SS). However, the tensile elongation of 316 + Ti tends to saturate with increasing fluence at 575°C whereas the elongation of 316 SS continues to fall for the fluences investigated. Reduction of area is similar for the two alloys, and 316 + Ti shows completely ductile rupture at 450°C and below. The differences in strength and ductility are attributed to the influence of TiC precipitates trapping helium in the matrix.

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REFER ALSO TO CITATION(S) 60765, 60986, 61008, 61678, 61678, 61822, 62478

61783 (BNL—31722) Neutron diffraction and scattering study on M/sub x/WO_3 (M=Rb and K). Sato, M.; Fujishita, H.; Moodenbaugh, A.R.; Hoshino, S.; Grier, B.H. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 14p. (CONF-820935—2). NTIS, PC A02/MF A01. Order Number DE82020027.

From 6. Yamada conference on neutron scattering of condensed matter; Tokyo, Japan (1 Sep 1982).

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To study the relationship between the lattice instability and the superconductivity of nonstoichiometric hexagonal tungsten bronze, M/sub x/WO_3, neutron diffraction and scattering studies were made. Two types of the structural phase transitions were observed. One is associated with the distortion of the corner linked WO_6 octahedra. The other is associated with the ordering of the M atoms which partially fill the sites in the WO_3 cage. A long period modulation of the structure appears for some values of x at low temperature. The discussion on the x dependence of the superconducting transition temperature is presented.

61784 (BNL—31791) Random fields and ordering in antiferromagnetic insulators. Cowley, R.A. (Brookhaven National Lab., Upton, NY (USA)). Aug 1982. Contract AC02-76CH00016. 10p. (CONF-820929—4). NTIS, PC A02/MF A01. Order Number DE82021566.

From IUPAP international conference on magnetism; Kyoto, Japan (6 Sep 1982).

Neutron scattering measurements of the effect on the long range order and phase transitions of random magnetic fields are reviewed. The results at low temperatures in Rb_2Co/sub x/Zn/sub 1-x/F_4 and Co/sub x/Zn/sub 1-x/F_2 show that the long range order is not established when samples are cooled in a magnetic field, but they form a state with unusually long magnetic correlations. In Mn/sub x/Zn/sub 1-x/F_2 a similar state is formed but only very close in temperature to T/sub N/.

61785 (CONF-810809—28) Interpretation of specific-heat and spontaneous-magnetization anomalies at the reentrant superconducting - ferromagnetic transition in ($Ho_{0.6}Er_{0.4}$)Rh_4B_4. Woolf, L.D.; Johnston, D.C.; Mook, H.A.; Koehler, W.C.; Maple, M.B.; Fisk, Z. (Exxon Research and Engineering Co., Linden, NJ (USA). Corporate Research Science Lab.; Oak Ridge National Lab., TN (USA); California Univ., San Diego, La Jolla (USA). Inst. of Pure and Applied Physical Sciences). Sep 1981. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01. Order Number DE82020890.

From 16. international conference on low temperature physics; Los Angeles, CA, USA (19 Aug 1981).

Analysis of neutron-diffraction data on the compound ($Ho_{0.6}Er_{0.4}$)Rh_4B_4 indicates that the Curie temperature is depressed by about 0.2 K due to the occurrence of superconductivity, in agreement with theoretical predictions. The temperature dependence of the specific heat in the vicinity of the first-order reentrant superconducting - ferromagnetic transition was computed by means of a simple model from the temperature dependence of the spontaneous magnetization of the Ho ions and was found to be in good agreement with the experimental data.

61786 (DOE/ET/15328—T1) Characterization of the adherence of plasma-sprayed ZrO_2 coatings. Becher, P.F.; Rice, R.W. (Naval Research Lab., Washington, DC (USA)). 1980. Contract AB03-78ET15328. 16p. NTIS, PC A02/MF A01. Order Number DE82008637.

Analysis of the microstructure and adherence of ZrO_2 coatings revealed that the adherence decreased with increasing coating thickness and could be increased by incorporating MgO as a second phase as well as by including noncubic ZrO_2 in the cubic ZrO_2 coating. Residual stresses from the plasma spraying process limit adherence (hence the coating thickness dependence) but these can be relieved by plastic flow in the MgO phase during post-spray cooling. Some degree of strength/toughening is also derived by the presence of microcracks and/or from transformation associated with the presence of tetragonal ZrO_2.

61787 (LAFI—028) Sulfate ion impurity as a sensor for point defects and dislocations in alkali halide crystals. Anion vacancy. Zeikats, V.P.; Schmite, I.K.; Zakis, J.R. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1981. 10p. (CONF-810573—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702604.

From International conference on defects in insulating crystals; Riga-Salaspils, USSR (18 May 1981).

A study of the vibrational spectrum of the molecular impurity ions in ionic crystals is proposed as a selective method for the direct investigations of point defects and dislocations in wide temperature range up to the melting point and even higher. The method is based on the sensitivity of intramolecular vibrations (IMV) of a molecular impurity to the presence of lattice defects in the nearest heigbourhood of the molecular ion. The method is restricted by the possibility to detect directly only defects interacting with the molecular impurity used as a detector. The migration of anion vacancies in KBr crystals in the temperature range from the room temperature to the melting point is studied in detail with sulphate ion. The IMV of the sulphate ions are determined from IR absorption spectra. By assuming the leading role of only one microprocess in any observed macroprocess in a certain temperature region, the following energies have been determined: the migration activation energy of a single anion vacancy in unperturbated lattice-0.9 eV; the upper limit of the anion vacancy migration activation energy in the quenched crystal-1.4 eV; the lower limit of the thermal generation of anion vacancy in the annealed crystal-2.0 eV; the dissociation energy of the sulphate ion- anion vacancy complexes-2.3 eV; the disarrangement activation energy of the preliminary aligned sulphate ion-anion vacancy complexes-2.3 eV.

61788 (LAFI—030) Quantum-chemical investigations of the electronic structure, mechanism of radiation defect production and recombination in alkali halide crystals. Tiliks, Yu.E.; Dzelme, Yu.R.; Kotomin, E.A.; Shluger, A.L. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1981. 11p. (CONF-810573—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702605.

From International conference on defects in insulating crystals; Riga-Salaspils, USSR (18 May 1981).

The results of recent investigations of electronic and spatial structure as well as mechanism of radiation-induced production and tunneling recombination of defects in ionic crystals LiF and KCl are briefly summerized. The calculations have been performed in the framework of the semiempirical quantum- chemical method, which is the simplified version of the unrestricted Hartree-Fock-Rothaan method, and of a molecular cluster model.

61789 (LAFI—035) Effect of homologous impurities on primary radiation defect accumulation in alkali halides. Chernov, S.A.; Gavrilov, V.V. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1981. 8p. (CONF-810573—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702606.

From International conference on defects in insulating crystals; Riga-Salaspils, USSR (18 May 1981).

To clarify the mechanism of the effect of anion and cation homologous impurities on the primary radiation-induced defect accumulation, the transient absorption of H and F centers was studied in KCl and KBr crystals. Pulse electron accelerator technique was used. Pure and doped crystals were investigated. It was obtained

that the cation homologue Na in the concentration range from 0 to 0.5 m. % in 10^{-8}-10^{-6} s post-irradiation time has no effect on the defect accumulation efficiency at low temperature and increases the latter at high temperature. At large post-irradiation time and at high temperatures the rise of efficiency at low Na concentration and decrease of it at high Na concentrations were observed. The conclusion was made that Na does not affect the generation process. The anion homologous impurities (I and Br) lead to a significant increase of the accumulation efficiency due to the formation of more stable F-H pair at self-trapped exciton decay on anion impurities compared with that formed in perfect lattice. Some assumptions are advanced to explain the effect.

61790 **(LAFI—036) Effect of radiation effects on optical spectra of Nisub(c)Mgsub(1-c)O single solid solutions.** Mironova, N.A.; Skvortsova, V.N.; Ulmanis, U.A. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1981. 7p. (CONF-810573—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702607.

From International conference on defects in insulating crystals; Riga-Salaspils, USSR (18 May 1981).

The results of investigation on the effect of radiation- induced defects on the optical absorption spectra of Ni^{2+}- doped MaO monocrystals are presented. Radiation defects were created by irradiation with X-rays, 3.5 MeV electrons, ^{60}Co gamma-rays, and neutrons with energy > 0.1 MeV. The optical absorption bands were measured at the 200-1300 nm. The change in the optical spectra with nickel concentration growth from 1 to 5% at different temperatures (77 and 300 K) were observed. It is proved that the intensity of the absorption bands caused by the spin-forbidden transitions (SFT) increases with the temperature decrease. So the conclusion is made that the electron SFT of Ni^{2+} in MgO occur due to the exchange interactions. Irradiation with ionizing radiations does not affect the absorption spectra, only new lines appear corresponding to Ni^{+} and Ni^{3+} ions. Electron irradiation leads to an insignificant increase in intensity of the absorption bands associated with SFT. Neutron irradiation causes sonsiderable changes in the spectra at the nickel concentration <= 0.05. That increase in intensity due to SFT depends on the neutron dose rate.

61791 **(LAFI—038) Basic mechanisms of color centres production by excitons in activated alkali halides.** Vale, G. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1981. 10p. (CONF-810573—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702608.

From International conference on defects in insulating crystals; Riga-Salaspils, USSR (18 May 1981).

The paper deals with some peculiarities of colour centers formation which are caused by introduction of the activator in alkali halide crystals. The crystals of KBr and KI activated with Tl^{+}, In^{+}, Sn^{++} in concentrations 10^{17}-10^{18} cm^{-3} and irradiated with ultraviolet light are studied. Excitation spectra of photostimulated activator luminescence and thermoluminescence were measured. The kinetics of the photostimulated activator luminescence is studied. The conclusion is made that the activator does not affect the primary reaction of exciton decay with F-H pair generation, but only the secondary reactions of colour center production.

61792 **(LAFI—041) Colloidal centres formation in alkali halide crystals under irradiation.** Ekmanis, Y.A.; Pirogov, F.V.; Rabsha, S.Y. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1981. 8p. (CONF-810573—7). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702609.

From International conference on defects in insulating crystals; Riga-Salaspils, USSR (18 May 1981).

Kinetics of the electron radiolysis products accumulations in alkali halide crystals after electron irradiation (3.5 MeV, 0.45 $Mradxsec^{-1}$) in the absorbed dose interval from 10^{2} up to $5x10^{4}$ Mrad at high temperatures (400 up to 1000 K) has been studied. The investigation methods comprise optical spectroscopy, electron microscopy, chemical analysis of crystal dissolution products electron microdiffraction, measurement of stored energy. It shown that colloid particles distribution with respect to particle size i s widened with absorbed dose increasing and its maximum is shifted to larger particles. But at higher temperature of irradiation (870 K) the distributions cease to depend on irradiation dose absorbed and are fully determined by the irradiation temperature. The analysis of the temperature dependence of the colloid formation process in NaCl crystal allows one to outline three stages of the process: the first stage up to 520 K is characterized by intensive coagulation (the increase of colloidal particles number and size); thermal distruction of alkaline metal colloidal particles and chemical transformations of them into alkaline metal oxide colloidal particles are characteristic of the second stage (520 up to 670 K); at the third stage the next increase of colloidal particles concentration due to oxidation process is observed. It is shown also that the dose rate increase in several times leads to a considerable increase in colloidal metal yield.

61793 **(LAFI—042) Recombination luminescence from H centers and conversion of H centers into I centers in alkali iodides.** Berzina, B.J. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1981. 8p. (CONF-810573—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702610.

From International conference on defects in insulating crystals; Riga-Salaspils, USSR (18 May 1981).

The study is aimed at the search for H-plus-electron centers of luminescence and the investigation of the conversion of H- into I centers by the luminescence of H-plus-electron centers in alkali iodide crystals. KI, RbI and NaI crystals were studied at 12 K. H and F centers were created by irradiation with ultraviolet light corresponding to the absorption band of anion excitons. Then the excitation of electron centers by red light irradiation was followed. The spectra of stimulated recombination luminescence were studied. The luminescence of H-plus- electron centers had been observed and the conclusion was made that this center was formed on immobile H centers. In case of stable H centers the optically stimulated conversion of H centers into I centers occurs. The assumption is advanced on the spontaneous annihilation of near placed unstable F, H centers which leads to the creation of H-plus-electron luminescence centers and to the spontaneous H-I-centers conversion.

61794 **(LBL—14284) Observation of the habit-plane shift and the morphology of α'' nitride ($Fe_{16}N_2$) precipitate in α-Fe.** Shih, Y.C. (Lawrence Berkeley Lab., CA (USA)). Jun 1982. Contract AC03-76SF00098. 49p. NTIS, PC A03/MF A01. Order Number DE82022054.

Thesis. Portions of document are illegible.

The habit plane shift phenomenon of α'' nitride ($Fe_{16}N_2$) precipitate in α-Fe is discovered by TEM observation. The habit plane of α'' precipitate shifts from (100) toward (102). The angular shift increases as the precipitate grows. Also, the angular shift increases as the aspect ratio of α'' particle increased. This relation has been predicted by considering the finite thickness effect on Khachaturyan's elastic theory. The crystal structure of the habit shifted precipitate is found to be distorted from a tetragonal structure, the structure of the initial α'' precipitate. The real morphology of α'' precipitate at the early stage is revealed as a rosette pattern on (001) habit plane. The branches of the rosette point in <100> and <110> directions. The possible reasons for the rosette morphology are discussed.

61795 **(LBL—14621) Structure and properties of WSi_2 thin films for MOS devices.** Wu, L.K. (Lawrence Berkeley Lab., CA (USA)). Jun 1982. Contract AC03-76SF00098. 45p. NTIS, PC A03/MF A01. Order Number DE82020293.

Thesis.

Polycrystalline silicone has long been used as the gate and interconnection material in metal-oxide-semiconductor field-effect transistor (MOSFET) integrated circuits, but as the device dimensions are shrinking and circuits are growing larger, the relatively poor conductivity of poly-Si is limiting its performance. As an alternative, tungsten silicide on poly-Si is being considered. No research has yet been reported on the microstructure-properties of this system. In the present research, therefore, the annealing behaviors of coevaporated WSi_2 on p-doped poly-Si have been studied by x-ray diffraction, He^{+} - backscattering, transmission electron microscopy (TEM), and Auger/SIMS analysis. High temperature annealing of silicide results in crystallization of what appears to be amorphous layers of tungsten silicide as well as diffusion of phosphorous out of the poly-Si. An attempt is made to correlate the physical and chemical properties with device fabrication and performance.

61796 **(SAND—82-0773C) Photographic-image storage in ion-implanted PLZT ceramics.** Peercy, P.C.; Land, C.E. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 28p. (CONF-820945—1). NTIS, PC A03/MF A01. Order Number DE82021871.

From International conference on ion beam modification of materials; Grenoble, France (6 Sep 1982).

Photographic images can be stored in transparent lead lanthanum zirconate titanate (PLZT) ceramics using near-UV light with photon energies near the band gap energy of 3.42 eV. Coimplanting inert ions, e.g., Ar, Ne and He, into the surface exposed to image light can increase near-UV photosensitivity by a factor of almost 10^4, with no degradation of image quality, so that the exposure energy threshold is reduced from $\sim$ 100 mJ/cm^2 to $\sim$ 10 μJcm^2. Coimplanting chemically active and inert ions, e.g., Al or Cr and Ne, can result in similar improvement of the extrinsic (visible light) photosensitivity and in an essentially flat photoresponse from about 400 to 600 nm. In addition, thermal diffusion of Al followed by Ne implantation yield photosensitivity increases in the near-UV comparable to the best results obtained to date with ion implantation.

61797 **Neutron-diffraction study of the magnetic ordering in superconducting $NdRh_4B_4$.** Majkrzak, C.F.; Cox, D.E.; Shirane, G.; Mook, H.A.; Hamaker, H.C.; MacKay, H.B.; Fisk, Z.; Maple, M.B. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **26**: No. 1, 245-249(1 Jul 1982).

The results of neutron-diffraction measurements are reported which confirm the development of long-range magnetic order in superconducting $NdRh_4B_4$. Two distinct antiferromagnetic transitions occur below the superconducting phase-transition temperature T/sub SC/ = 5.4 K, one at T/sub MH/≅1.5 K and the other at T/sub ML/≅1.0 K. In both phases, the body-centered tetragonal sublattice of Nd atoms orders antiferromagnetically with the Nd^{3+} moments aligned along the unique c axis. The magnetic moment is modulated sinusoidally along the [100] direction in the higher-temperature magnetic phase and along the [110] direction in the lower-temperature phase. The measured saturation moment is 3.4 +- 0.5μ/sub B/. No ferromagnetic component could be detected in the higher-temperature magnetic phase within an experimental sensitivity of 0.3μ/sub B/.

61798 **Solid electrolytes: the beta aluminas.** Bates, J.B.; Wang, J.; Dudney, N.J. (Oak Ridge National Laboratory). *Physics Today;* **35**: No. 7, 46-53(Jul 1982).

Materials in which lattice defects allow ions to flow rapidly have interesting physical properties and important applications in new electrochemical devices such as sodium-sulfur batteries.

61799 **14 MeV neutron irradiation effects in MACOR glass-ceramic.** Fowler, J.D. Jr.; Hurley, G.F.; Kennedy, J.C.; Clinard, F.W. Jr. (Los Alamos National Lab., NM (USA)). *Journal of Nuclear Materials;* **103**: No. 1-3, 755-760(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Samples of MACOR machinable glass-ceramic were irradiated at room temperature to fluences of 10^{20} and 10^{22} n/m^2. No significant volume changes or deterioration in thermal conductivity were detected, while strength appeared to increase slightly. A slight increase in electrical conductivity, which disappeared with annealing, was noted for the higher fluence. Examination of ion-thinned samples by TEM showed only minor damage from the high-fluence neutron irradiation, where ionizing doses are estimated to be 10^7 Gy. Exposure to higher doses from 200-KeV electrons in the TEM caused the formation of pore-like aggregates.

61800 **Structural properties of MgO and $MgAl_2O_4$ after fission neutron irradiation near room temperature.** Hurley, G.F.; Kennedy, J.C.; Clinard, F.W. Jr. (Los Alamos National Lab., NM (USA)); Youngman, R.A. (Case Western Reserve Univ., Cleveland, OH (USA)); McDonell, W.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). *Journal of Nuclear Materials;* **103**: No. 1-3, 761-766(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Polycrystalline MgO and $MgAl_2O_4$ (spinel) samples were irradiated at 430 +-5 K in HFIR to a fast neutron fluence of 2.1 x 10^{26} n/m^2, Esub(n) > 0.2 MeV, and 4.6 x 10^{26} thermal n/m^2. Swelling, microstructure, and mechanical strength were evaluated after irradiation and compared to control samples. Both materials swelled substantially, 2.6-3.0% in the case of MgO, and 0.8% in the case of $MgAl_2O_4$. The substructure of the MgO was found to contain a dense array of dislocation loops while the spinel showed heavy, but unresolved damage. Results of diametral compression testing showed significant strengthening for both materials. This result has important implications for the use of cubic technological ceramics in fusion applications.

61801 **Radiation damage from alpha decay in ceramic nuclear waste forms.** Weber, W.J.; Turcotte, R.P.; Roberts, F.P. (Pacific Northwest Lab., Richland, WA (USA)). *Radioactive Waste Management;* **2**: No. 3, 295-319(Mar 1982).

The effects of radiation damage on ceramic forms of nuclear waste solids have been studied by actinide-doping techniques and by external alpha irradiation. The results of several other investigations on simulated ceramic waste forms are reviewed, and the expected phase behavior, in general, is discussed based on rare-earth chemistry, X-ray diffraction data, and available information on both self damage in actinide compounds and irradiation damage in other ceramic materials.

3603 Composite Materials

REFER ALSO TO CITATION(S) 61461, 61542, 61897

61802 **(UCRL—87601) Inverse problem in viscoelasticity.** Thigpen, L.; Hedstrom, G.W.; Bonner, B.P. (Lawrence Livermore National Lab., CA (USA)). Aug 1982. Contract W-7405-ENG-48. 8p. (CONF-820820—3). NTIS, PC A02/MF A01. Order Number DE82021927.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

Calculation of attenuation and dispersion spectra for a general anelastic body may be posed as an inversion problem. We observe the time-dependent strain due to instantaneous changes in stress in order to characterize the anelastic response. This experimental technique reaches a range of frequencies which is lower than that used in resonance bar experiments, but we can make only indirect measurement of the viscoelastic properties. We employ the most general anelastic model which states that the observed compliance is due to the summed effect of an arbitrary spectrum of mechanisms. The analysis requires the solution of Fredholm integral equations of the first kind. It is well known that this problem is ill-conditioned so that any numerical scheme will have to involve some smoothing to obtain accurate solutions. The present work employs Butler's method of constrained regularization which takes advantage of the fact that the solution is positive and uses data dependent smoothing. This work indicates that the imposition of the positivity constraint makes the computation of the solution much better conditioned. Computations with the method of constrained regularization employing near-optimal smoothing demonstrate its superiority over the method of Shapery for obtaining accurate solutions when the data are very noisy.

3604 Polymers And Plastics

61803 **(BDX—613-2825) Determination of silanol in silicones by quantitative FTIR.** Griffith, G.W. (Bendix Corp., Kansas City, MO (USA)). Aug 1982. Contract AC04-76DP00613. 25p. (CONF-820850—1). NTIS, PC A02/MF A01. Order Number DE82020342.

From Society for Applied Spectroscopy and Rocky Mountain Chromatography Group conference; Denver, CO, USA (1 Aug 1982).

A great many two-component silicone resins depend upon the reaction of a silane-hydrogen containing (SiH) material with a silanol containing (SiOH) material. There are many methods that

work quite well for the quantitation of SiH. There are probably even more methods available for SiOH determination. Unfortunately, most of them suffer from large disadvantages. This laboratory has has tried nearly every available method for silanol analysis in an effort to find a reliable one. As a result, an infrared method has been developed that is not only fast and reliable but has very vew interferences. The method involves measuring the absorbance of the non-bonded SiOH band (3685 cm-1) of very dilute solutions of the silanol in carbon tetrachloride. The analysis is performed on an FTIR spectrophotometer, and the effects of moisture and other interfering species are digitally subtracted. The choice of a suitable standard silanol proved to be one of the most difficult problems to overcome, since the absorptivity coefficient is somewhat structure dependent. The method is now being used on a routine basis.

61804 **(UCID—19447) Design methodology for cushions.** Christensen, R.M.; Feng, W.W.; Lepper, J.K. (Lawrence Livermore National Lab., CA (USA)). Mar 1982. Contract W-7405-ENG-48. 5p. NTIS, PC A02/MF A01. Order Number DE82019263.

A procedure is developed whereby the porosity and the vinyl content in silicone/vinyl cushions can be predicted in order to meet a specified level of compressive deformation. Illustrative design examples are given and restrictions upon the method are discussed.

61805 **Plane shock initiation of detonation in γ-irradiated pentaerythritol tetranitrate.** Dick, J.J. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **53**: No. 9, 6161-6167(Sep 1982). Contract W-7405-ENG-36.

The effect of γ irradiation on shock initiation sensitivity of pentaerythritol tetranitrate (PETN) single-crystal explosive was studied experimentally. Shock input strength was 8.6 GPa and detonation transition occurred after 7.3 mm of shock run for as-grown {110} crystals. Other crystals were given γ-ray doses of up to 1 Mrad from a ^{60}Co source. Crystals were sensitized by doses greater that 0.6 Mrad, with 1 Mrad shortening the distance to detonation transition by almost 40%. The initiation process is apparently still of the homogeneous type. Irradiated crystals were studied by optical microscopy. Evidence of the presence of gas molecules produced by decomposition of PETN molecules induced by γ rays was observed. Platelets 20—50 μm in diameter and about 0.25 μm thick were noted inside the crystal 30 days after irradiation. Growth of penny-shaped crack-flaws was observed and attributed to buildup of internal strains generated by the decomposition gas pressure. It is hypothesized that the source of the increased shock sensitivity after irradiation is due to the additional decomposition sites generated by decomposition of PETN molecules by γ-ray excitation. These sites act as additional nuclei for thermal decomposition in the shocked material.

3606 Other Materials

REFER ALSO TO CITATION(S) 61076, 61080, 61081, 61596, 61596, 61799

61806 (INIS-SU—38, pp 13-34) **Scintillation process in alkaline-halide crystals.** Lyapidevskij, V.K.; Prorvich, V.A. 1978. (In Russian). Dep. NTIS (US Sales Only).

In Experimental methods in nuclear physics. No. 3. Collection of scientific papers.

For the purpose of studying the processes energy of transfer from the basic substance to luminescence centers theoretical and experimental investigations of the scintillation process in alkaline-halide crystals are carried out. The electron-hole energy transfer mechanism is considered and two models of this process are suggested. The technique of experimental study of the scintillation process is considered in detail. Functional flowsheets of the installation operating by a single photon method is presented. This installation has been used to investigate the effect of electric fields and infrared radiation on the scintillation process in alkaline-halide crystals. The dependences of scintillation pulse rise time on temperature for the CsJ(Tl) and CsJ(Na) crystals with a different activator content are measured and the scintillation pulse shape in these crystals is investigated. On the base of obtained results the conclusion is drawn that in the crystals on the CsJ base the excitation energy transfer to scintillation centers is realized by Vsub(k) centers moving with activation energy equal 0.13 eV. Scintillations with rise time of 1 ns order in scintillators CsJ, CsJ(Tl), CsJ(Na), KJ(Tl), CaF_2(Eu), KJ, CaF_2 have been found. It is established that the electrical field and infrared radiation reduce the rise time of activator luminescence in CsJ(Tl) and CsJ(Na) crystals. The study carried out furnishes data directly on the scintillator energy transfer in scintillator which allows in its turn to change purposefully scintillation pulse parameters for various scintillators.

61807 **(LBL—14755) Contribution of the Staebler-Wronski effect to gap-state absorption in hydrogenated amorphous silicon.** Amer, N.M.; Skumanich, A. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 2p. (CONF-820937—2). NTIS, PC A02/MF A01. Order Number DE82019739.

From 16. international conference on the physics of semiconductors; Montpellier, France (6 Sep 1982).

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The contribution of light-induced conductivity and luminescense changes to gap-state absorption in a-Si:H was directly measured by photothermal deflection spectroscopy. It is shown that sample illumination enhances gap-state absorption while annealing restores its magnitude to the original level. Doping further enhances this absorption while compensation results in the smallest observed effect. The energy position of the affected states are determined to be 1.2-1.3 eV below the conduction band and tentatively attribute the enhancement to Si dangling bonds created by breaking the Si-Si bonds.

61808 **(MC-NW—97/80) Numerical solution of a diffusion problem with segregation at a moving interface.** Bakker, M.; Hoonhout, D. (Stichting Mathematisch Centrum, Amsterdam (Netherlands)). Dec 1980. 21p. NTIS, PC A02/MF A01.

The transport of impurities implanted in silicon, which accompanies the annealing of implantation damage by means of pulsed-laser irradiation, is described by a one-dimensional diffusion equation whose solution is discontinuous at a moving interior point. This discontinuity is due to segregation of mass at the liquid/solid interface during (re)solidification. Problems in the numerical solution of the equation are examined.

61809 **(ONWI—324) PSU/WES interlaboratory study of an experimental cementitious repository seal material.** Roy, D.M.; Grutzeck, M.W.; Mather, K.; Buck, A.D. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.; Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Aug 1982. Contract AI97-81ET46633;AC06-76RL01830. 160p. NTIS, PC A08/MF A01. Order Number DE82021541.

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Two separate laboratories are investigating the possible use of portland-cement grout as a repository sealing material for underground isolation of nuclear waste. The laboratories are the Materials Research Laboratory of The Pennsylvania State University (PSU) and the Structures Laboratory (SL) of the US Army Engineer Waterways Experiment Station (WES). The project manager, Mr. Floyd L. Burns of the Office of Nuclear Waste Isolation (ONWI), suggested that these laboratories make a comparative study to determine their ability to obtain results of similar precision and accuracy on potential repository seal materials. This report gives the results of this study. The same cementitious grout mixture was prepared in each laboratory in September 1980, and tests were started. Tests included characterization of cement and fly ash by chemical, physical, x-ray diffraction, and other procedures. Tests of hardened specimens included restrained expansion, compressive strength, modulus of elasticity, density, and permeability and characterization by x-ray diffraction and scanning electron microscopy. Each laboratory made many of the same tests and some that were not directly comparable. There was generally good agreement between the results of the tests that were performed by both laboratories. The results indicated that the starting materials received from a common source were highly similar as evaluated in the two laboratories.

61810 **(SAND—82-0780C) Laser-diode-induced photobleaching at low temperatures in Co-60 irradiated fibers.** Barnes, C.E. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1982. Contract AC04-76DP00789. 27p. (CONF-820708—9). NTIS, PC A03/MF A01. Order Number DE82020982.

From IEEE annual conference on nuclear and space radiation effect; Las Vegas, NV, USA (20 Jul 1982).

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Laser-diode (830 nm)-induced photobleaching effects have been studied primarily at -55°C in a variety of fibers including polymer-clad pure-silica core, fluorosilicate-clad pure-silica core, and doped core fibers which were exposed to Co-60 irradiation with and without simultaneous CW laser light passing through the fibers. Thermal and laser-induced recovery at -55°C following irradiation was also examined. Those fiber parameters which were found to affect the extent of photobleaching were dopant content in the core, especially phosphorus, OH concentration in the core, and saturation of induced attenuation. The optimum fiber which shows minimal attenuation after irradiation and photobleaching is one that has an undoped core with high OH content.

61811 **(SAND—82-0787C) Measurements of the melt dynamics in laser-annealed semiconductors.** Peercy, P.S.; Galvin, G.J.; Thompson, M.O.; Mayer, J.W.; Hammond, R.B. (Sandia National Labs., Albuquerque, NM (USA); Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science; Los Alamos National Lab., NM (USA)). 1982. Contract AC04-76DP00789. 6p. (CONF-820828—4). NTIS, PC A02/MF A01. Order Number DE82020407.

From 9. EPS Nuclear Physics Divisional conference on nuclear structure; Amsterdam, Netherlands (29 Aug 1982).

Portions of document are illegible.

Combined measurements of the transient electrical conductance, optical reflectance and absorbed energy have been used to determine the dynamics of the annealing process during laser irradiation of bulk silicon and silicon on sapphire. The combined transient conductance and optical reflectance yield the regrowth velocity and melt duration in bulk silicon; in silicon on sapphire the measurements also yield the melt velocity and maximum melt depth. Measurement of the absorbed energy provides energy coupling data used in numerical calculations of the melt dynamics for direct comparison with experiment in bulk silicon and the result indicates annealing proceeds by a purely thermal process.

61812 **Effect of bias on radiation-induced paramagnetic defects at the silicon-silicon dioxide interface.** Lenahan, P.M.; Dressendorfer, P.V. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **41**: No. 6, 542-544(15 Sep 1982). Contract AC04-76DP00789.

Electron spin resonance measurements have been made on gamma-irradiated (111) Si/SiO_2 structures as a function of bias across the oxide. We observe a large change in the density of radiation-induced paramagnetic P/sub b/ centers with bais. We conclude that P/sub b/ defects (trivalent silicons at the Si/SiO_2 interface) account for a very large portion of the radiation-induced interface states.

61813 **Energy transfer in LaF_3: R^{3+}, Pr^{3+} (where R = Nd, Dy).** Reddy, B.R.; Venkateswarlu, P. (Department of Physics, Indian Institute of Technology, Kanpur 208016, India). *Journal of Chemical Physics;* **77**: No. 6, 2862-2869(15 Sep 1982).

Fluorescence is observed for $^1D_2$ levels of Pr^{3+} on exciting the higher lying level $^3P_0$ in doubly doped systems LaF_3: R^{3+}, Pr^{3+} (R = Nd or Dy) but not in LaF_3:Pr^{3+}. From the recorded excitation spectra, and the measured decay times, it has been found that the drain mechanism of population to $^1D_2$ levels is caused in doubly doped systems by ion-pair relaxation between Pr^{3+} ($^3P_0$—$^1D_2$) and Nd^{3+} (Z-X) or Dy^{3+} (Z-Y) ions.

61814 **Reply to the previous comments by Shibamura et al.** Ascarelli, G. (Department of Physics, Purdue University, W. Lafayette, Indiana 47907). *Journal of Chemical Physics;* **77**: No. 6, 3291-3292(15 Sep 1982).

It is pointed out that in the case of high fields the Townsend method discussed in the previous letter does not give a direct measure of the averege carrier because the electron distribution is anisotropic. An estimate of the rms depth of traps originating from density fluctuations is given based on the recent calculation of the electron mobility by Basak and Cohen. This value is in excellent agreement with those of the present author based on a completely different type of reasoning.

61815 **Effects of Cd-vapor and Te-vapor heat treatments on the luminescence of solution-grown CdTe:In.** Norris, C.B.; Zanio, K.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **53**: No. 9, 6347-6359(Sep 1982).

We have employed cathodoluminescence at 80—300 K in the first comprehensive study of the effects of Cd-vapor or Te-vapor heat treatments on the luminescence of solution-grown CdTe:In. The broad 1.4-eV band present in as-grown material is weakened by Te firing and typically enhanced by Cd firing. These results do not support earlier connections between this luminescence and the V/sub Cd/-In/sub Cd/ complexes predicted by defect chemistry calculations to be dominant in CdTe:In. Alternatives to straightforward interpretation are discussed for both experiments and defect modeling. The effects of the heat treatments on the injection-level dependence, frequency response, and temperature dependence of the 1.4-eV luminescence are described. This luminescence arises from localized transitions within compact complexes in our as-grown material, but different species of complexes or competing transition mechanisms are involved in heat-treated material. The edge emission, present in both as-grown and fired material, peaks near 1.57 eV at 80 K and thus is close to the band-gap energy of CdTe. However, frequency-response data reveal anomalous energy-storage processes which can slow the edge-emission kinetics to the microsecond regime following Cd firing. Another surprising result is the strong coupling in both kinetics and injection-level dependence between the edge emission and a sharp extrinsic band near 1.54 eV which is prominent in Te-fired CdTe.

61816 **Effect of oxygen on chromium-structural defects interaction in ion-implanted gallium arsenide.** Sadana, D.K.; Washburn, J.; Zee, T.; Wilson, R.G. (University of California, Lawrence Berkeley Laboratory, Materials and Molecular Research Division, Berkeley, California 94720). *Journal of Applied Physics;* **53**: No. 9, 6413-6417(Sep 1982). Contract W-7405-ENG-48.

The redistribution of chromium in gallium arsenide implanted with either gallium and arsenic or gallium, arsenic, and oxygen and subsequently furnace annealed was studied by secondary ion mass spectrometry. The depth distribution of the residual damage was obtained by cross-sectional transmission electron microscopy. At annealing temperatures of $<$ or $=$600 °C, there was a one to one depth correlation between the positions of the damage layers and peaks in the atomic profile of chromium. However, at annealing temperatures of $>$ or $=$800 °C such correlations were complicated by oxidation effects.

61817 **Variation of the refractive index with temperature and the tuning rate for KDP isomorphs.** Barnes, N.P.; Gettemy, D.J.; Adhav, R.S. (Los Alamos National Laboratory, University of California, P. O. Box 1663, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America;* **72**: No. 7, 895-898(Jul 1982).

The variation of refractive index with temperature is measured as a function of wavelength, temperature, and polarization for KDP and eight of its isomorphs. These data are used to predict the tuning rate for second harmonic generation as a function of temperature. The predicted tuning ratio compares well with the measured tuning rate. Reasonable agreement is found in most cases, the principal exceptions being those cases in which the data must be extrapolated signficantly beyond the range of the measured values.

61818 **Effects of temperature and crystal defects on electron channeling radiation.** Swent, R.L.; Pantell, R.H. (Stanford Univ., CA (USA). Dept. of Electrical Engineering); Datz, S. (Oak Ridge National Lab., TN (USA)); Alvarez, R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 235-237(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Channeling radiation from relativistic electrons has been studied by several groups in the past few years, and the basic mechanism is understood. There are, however, a number of areas remaining to be explored. Bound-state population lengths, which are determined by non-radiative transitions, are much longer than coherence lengths, resulting in radiation intensities appreciably greater than initially expected. Experimental results have been obtained which demonstrate this effect. Also, the temperature dependence of channeling radiation from Si has been measured recently. In addition, experiments have been performed on Si and diamond crystals with defects, to determine the effect of crystalline imperfections upon channeling radiation.

61819 **In situ Rutherford backscattering analysis of radiation-induced segregation.** Averback, R.S.; Rehn, L.E.; Wagner, W.; Okamoto, P.R.; Wiedersich, H. (Argonne National Lab., IL (USA). Materials Science Div.). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 457-460(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Radiation-induced segregation of Ni-12.7 at.% Si during 2.0 MeV He and 3.25 MeV Kr irradiation has been investigated. Using high resolution Rutherford backscattering spectrometry, the rate of segregation of Si at the irradiated surface was determined. During the He irradiation, the amount of Si segregation was found to be proportional to the square root of the dose. From the dependence of segregation on temperature, for both He and Kr irradiations, an apparent activation enthalpy of 0.3 eV was deduced for the segregation process. A comparison of the segregation rates during the He and Kr irradiations revealed that on the basis calculated dpa rates, He irradiation is significantly (approx. equal to6X) more effective than Kr irradiation for inducing segregation.

61820 **Trapping and release of implanted D/H ions in fused silica.** Arnold, G.W.; Doyle, B.L. (Sandia National Labs., Albuquerque, NM (USA)). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 491-495(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Elastic recoil detection techniques have been used to measure hydrogen isotope profiles in fused silica implanted with 20 keV H and/or D ions. Saturation is obtained for both H and D implantations at concentrations of 21 x 10^{21} ions/cm^3, in good agreement with results of gas loading experiments. Infrared measurements indicate that most of the implanted H bonds in the form of OH. Theoretical analyses using the local mixing model (LMM) of H-trapping provide a good fit to the saturation behavior and subsequent H movement toward the surface. Isochronal annealing shows that both H and D are released in a single stage centered about 550°C. The best theoretical fit is for a 1.9 eV H-trap activation energy.

61821 **Numerical modeling of concrete under thermal loads.** Marchertas, A.H.; Kulak, R.F. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* **68**: No. 2, 225-236(Mar 1982).

From International seminar on internal loading and containment of fast breeder reactors (CONFABRE-3); Ispra, Italy (24 - 25 Aug 1981).

The formulation needed for the conductance of heat by means of explicit integration is presented. The implementation of these expressions into a transient structural code, which is also based on explicit temporal integration, is described. Comparisons of theoretical results with code predictions are given both for one-dimensional and two-dimensional problems. The coupled thermal and structural solution of a concrete crucible subjected to a sudden temperature increase predicts the history of cracking. The extent of cracking is compared with experimental data.

61822 **Neutron irradiation effects on SiO_2 and SiO_2-based glass ceramics.** Porter, D.L.; Pascucci, M.R.; Olbert, B.H. (Argonne National Lab., IL (USA); Case Western Reserve Univ., Cleveland, OH (USA); Rensselaer Polytechnic Inst., Troy, NY (USA)). *Journal of Nuclear Materials;* **103**: No. 1-3, 767-772(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

A preliminary data base to assess the radiation damage resistance of some glass ceramic materials has been gathered. These are rather complex materials, both in structure and composition, but possess many of those properties required for structural, insulator applications in fusion reactor design. Property measurements were made after fast ($E > 0.1$ MeV) neutron irradiations of approx. equal to 2.4 x 10^{22} n/cm^2 at 400°C and 550°C. The results have shown general resistance to changes in thermal expansion and most did not experience severe loss of mechanical integrity. The maximum volume expansion occurred in several of the fluorophlogopite-based glass ceramics (approx. equal to 3.0%). Several observations demonstrated differences between the effects of neutron and electron irradiation; irradiation conditions prototypic of projected reactor uses need to be considered for optimum materials selection.

61823 **Response of metallic glasses $Fe_{40}Ni_{40}P_{14}B_6$ and $Fe_{80}B_{20}$ to irradiation with 800 MeV protons.** Cost, J.R.; Sommer, W.F. (Los Alamos National Lab., NM (USA)). *Journal of Nuclear Materials;* **103**: No. 1-3, 773-778(Mar 1982).

From 2. topical meeting on fusion reactor materials; Seattle, WA, USA (9 - 12 Aug 1981).

Metallic glasses with compositions of $Fe_{40}Ni_{40}P_{14}B_6$ and $Fe_{80}B_{20}$ were irradiated in the 800 MeV proton beam at the Los Alamos Meson Physics Facility while the electrical resistance and length changes were monitored. The resistance and the length of the first alloy were both found to increase and saturate with dose to $\Delta R/R$ approx. equal to 5 x 10^{-3} and $\Delta L/L$ approx. equal to 2 x 10^{-3}. For the second alloy the total dose of 1.1 x 10^{19} p/cm^2, which was calculated to give roughly 0.12 dpa, was slightly less than that required for saturation. No annealing of these increases was observed for anneals from room temperature to 250°C. These results are interpreted in terms of a model in which collision cascades create small regions of increased atomic disorder which fully overlap each other at saturation.

61824 **Radiation effects in high-level radioactive waste forms.** Turcotte, R.P. (Pacific Northwest Lab., Richland, WA (USA)). *Radioactive Waste Management;* **2**: No. 2, 169-177(Dec 1981).

Radiation from decay of actinide elements is shown to produce saturation changes in bulk properties of waste forms near 10^{19} alpha decays/cm^3 (<approximately 1 dpa). Accelerated actinide doping experiments in this dose range show only slight radiation induced changes in leach rates of nuclear waste glasses.

40 CHEMISTRY

61825 **(DOE/ER—0144) Summaries of FY 1982 research in the chemical sciences.** (Department of Energy, Washington, DC (USA). Div. of Chemical Sciences). Sep 1982. 196p. NTIS, PC A09/MF A01. Order Number DE82021016.

The purpose of this booklet is to help those interested in research supported by the Department of Energy's Division of Chemical Sciences, which is one of six Divisions of the Office of Basic Energy Sciences in the Office of Energy Research. These summaries are intended to provide a rapid means for becoming acquainted with the Chemical Sciences program to members of the scientific and technological public and interested persons in the Legislative and Executive Branches of the Government. Areas of research supported by the Division are to be seen in the section headings, the index and the summaries themselves. Energy technologies which may be advanced by use of the basic knowledge dis-

covered in this program can be seen in the index and again (by reference) in the summaries. The table of contents lists the following: photochemical and radiation sciences; chemical physics; atomic physics; chemical energy; separation and analysis; chemical engineering sciences; offsite contracts; equipment funds; special facilities; topical index; institutional index for offsite contracts; investigator index.

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REFER ALSO TO CITATION(S) 60766, 60772, 60889, 60936, 60938, 60939, 60939, 60961, 61868, 61956

61826 (CONF-8103113—, pp 82-97) **Neutron cross-section determination in geological samples (U).** Harris, J.M.; McDaniel, P.J. (Sandia National Labs., Albuquerque, NM). Apr 1982. NTIS, PC A12/MF A01.

From Western tight gas sands advanced logging workshop; Tulsa, OK, USA (17 Mar 1981).

The Prompt Gamma Neutron Activation Analysis (PGAA) technique yields elemental composition data which can be used to calculate the macroscopic cross section for any sample. The Small Sample Reactivity Measurements (SSRM) technique yields the macroscopic thermal absorption directly. Experimentally, PGAA is somewhat more difficult because of the calibration and data handling than is SSRM. However, SSRM requires a mathematical model of the reactor which means a rather complicated analysis. Once the model and calibration are completed, data analysis is routine. The SSRM technique is production oriented. 9 figures.

61827 (CONF-8108139—1-Draft) **Transferability of enzyme reference methods to the clinical laboratory.** Burtis, C.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01. Order Number DE82020913.

From Conference on analytical goals in clinical enzymology; Aspen, CO, USA (18 Aug 1981).

This paper discusses the transfer step in the development of a reference method for the purification and characterization of enzymes. (ACR)

61828 (DOE/BETC/TPR—82/1) **Automated probe microdistillation/mass spectrometry for the analysis of high-molecular weight compounds in fossil fuels.** Scheppele, S.E.; Grindstaff, Q.G.; Grigsby, R.D.; Chung, K.C.; Hwang, C.S.; Marriott, T.D.; Schronk, L.R. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Aug 1982. 24p. NTIS, PC A02/MF A01. Order Number DE82022039.

Automated probe microdistillation/mass spectroscopy is described. The application of computer hardware and the development of computer software eliminate the dilatory nature of acquiring both the temperature and associated mass spectra and reduces the acquired data for processing. The interaction of various hardware components of the system as well as the associated software is described. (DMC)

61829 (DOE/ER/10554—21) **Effects of temperature and mobile-phase composition on retentions in column liquid chromatography.** Hsu, A. (Ohio State Univ. Research Foundation, Columbus (USA). Dept. of Chemistry). Aug 1982. Contract AC02-80ER10554. 156p. NTIS, PC A08/MF A01. Order Number DE82020756.

Thesis.

Binary-additive mobile phase systems were investigated for a more exact control over chromatography. If the mobile phase was nonpolar binary solvents (e.g., n-hexane and dichloromethane), trace amounts of THF and/or ACN could be added to control solute retentions as a function of solvent composition. Temperature also plays an important role in the coverage of modifier molecules on the surface of the adsorbent. Higher efficiencies were obtained at lower temperatures. For chromatographic systems having large extra-column volumes, higher column temperature will also reduce column efficiency. Solvophobic effects and polar-group selectivity control the chromatographic behavior of phenols in reversed-phase liquid chromatography (RPLC). The former effect predominates with the THF system, and the latter with the MeOH system. Substituent groups decrease the hydrophobic effect of phenols in aqueous media. However, owing to steric effects, ortho-substituted phenols usually eluted later. Separation of the phenols was also found with 35% MeOH/H_2O eluent. Application of window diagrams led to baseline separation with 22% THF/H_2O. Optimum column temperature was 42°C with a Zorbax C8 microbore column. The enthalpy-entropy compensation principle was applied to the retention data observed with reversed-phase systems. Relative retention data were found to provide a more consistent compensation temperature. RPLC was shown to be useful in the separation of high molecular-weight compounds such as hydroxyl-terminated polybutadiene (HTPB). HMDS-treated HTPB eluted without difficulty from silical gel. Sample overload can provide unique separations in GPC. (DLC)

61830 (DOE/ER/10554—27) **Development and optimization of methodologies for analysis of complex hydrocarbon mixtures. Technical progress report, 1 September 1981-31 August 1982.** Laub, R.J. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). Aug 1982. Contract AC02-80ER10554. 64p. NTIS, PC A04/MF A01. Order Number DE82020764.

During the past year, several technical reports have appeared in the open literature from this Laboratory, and these and a number of others are included as supplemental reports to this document. All of these pertain to the optimization of gas- and liquid-chromatographic separations of complex mixtures of organic compounds of significance to the Department of Energy. Because of the very large amount of experimental information obtained during this period, only the highlights of selected research results are presented.

61831 (DOE/ER/10554—28) **Development and optimization of methodologies for analysis of complex hydrocarbon mixtures. Final technical report, 1 January 1980-31 August 1982.** Laub, R.J. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). Aug 1982. Contract AC02-80ER10554. 28p. NTIS, PC A03/MF A01. Order Number DE82021581.

This Final Technical Report summarizes the work carried out by the Principal Investigator over the period 1 January 1980 to 31 August 1982 at Ohio State University. The research has encompassed rotating-disk thin-layer chromatography, column liquid chromatography, and gas chromatography of hydrocarbon and related samples of interest to the Department of Energy. Because of the very large number of topics investigated, only the major results from each of the above research areas are presented in this report; reference should be made to the individual technical reports cited at the end of this document for further details, particularly progress reports DOE/ER/10554-7 and DOE/ER/10554-27. Also attached to this report is a Biography and List of Publications of the Principal Investigator (DOE-sponsored work is asterisked); a complete listing of reports issued by the PI for the duration of the grant is also provided.

61832 (INIS-SU—29, pp vp) **High-sensitive scintillation detection unit for activation analysis.** Ovechkin, V.V.; Panshin, A.Z.; Rudenko, V.S. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Radiation technology.

A design of high-sensitive scintillation detection unit of a well type with registration chamber, intended for conducting neutron-activation analysis of fluorine containing materials, is described. Detection unit contains a scintillation crystal of 150x150 mm dimension Registration chamber comprises two thin-wall coaxial cylinders. The chamber is located in the detector well. The detection unit is mounted in a protective house made of lead for γ-background level reduction. Energy resolution of the detection unit makes up 11% by γ-line with 0.662 MeV energy. Neutron-activation determination of fluorine is based on using ^{19}F (n, chemical bond)^{16}N nuclear reaction, passing during irradiation with fast neutrons. Dependence of output pulse amplitude on γ-quanta energy is presented. Comparison of the developed detection unit parameters with characteristics of serial detection units is also given. It is stated, that measuring method of induced activity by γ-radiation with 5-7 MeV energy is more effectively realized during using one

NaI(Tl)-detector of essential size with a well, in which registration chamber is mounted.

61833 (INIS-SU—29, pp vp) **Software of the MA-1 on-line system for activation analysis.** Anisimova, S.V.; Filippov, V.V. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Radiation technology.

Software of the MA 1 on-line system, developed for conducting instrumental activation analysis, is described. The M-6000 computer with fast frame 8 K memory, is used for spectrometric information storage, operation control of certain units and information processing. Programs of manual (RR-2) and automatic (AR-2) regimes of sample analyses are developed for providing working capacity of the MA-1 system. PR-2 program is intended for developing new analysis methods and for tuning spectrometric techniques. It permits storage and processing of information, information output on display or data signet in the form of a table. AR-2 program is intended to exercise control over operation of all the MA-1 system devices in the automatic regime. All the data necessary for the system operation (nuclear parameters and time constants) are introduced by teletype in the regime of M-6000 computer dialogue with the operator.

61834 (INIS-SU—29, pp vp) **Errors of the radioisotope measurement method in the case of measured parameter fluctuations.** Mashinin, V.A.; Pyatkova, A.V. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Radiation technology.

The purpose of the paper is to evaluate measuring errors of an average value of the measured parameter X by radioisotopic method. Asymptotic expressions for dispersion and average volume of counting under fluctuation conditions of the meassured parameter are obtained. Systematic measuring error can be evaluated by the formula: deltaxsub(system) approximately 3σsub(x)sup(2) anti x, where σsub(x)-mean square deviation of the measured parameter, anti x-mean value of the measured parameter.

61835 **(RFP—3359) Bifunctional organophosphorus extractants for actinide recovery and purification.** Muscatello, A.C.; Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 15 Apr 1982. Contract AC04-76DP03533. 11p. (CONF-8205122—1). NTIS, PC A02/MF A01. Order Number DE82021618.

From Actinide workshop; Augusta, GA, USA (11 May 1982).

The extraction chemistry of carbamoylmethylenephosphonates is currently under investigation at Rocky Flats for actinide recovery and purification. An overview of the current research efforts on these extractants are presented. The extractants studied most include the case where the R's represent hexyl, butyl, and ethyl groups, such as DHDECMP (dihexyl-N,N-diethylcarbamoylmethylenephosphonate) and DBDECMP (dibutyl-N,N-diethylcarbamoylmethylenephosphonate). The bifunctional organophosphorus extractants are being investigated for various applications at Rocky Flats. The applications include plutonium and americium recovery from acidic waste streams, separation of plutonium from mixed actinide residues, and purification of americium. The mechanisms of the synergistic extraction of Am (III) and Pu (IV) by bifunctional extractants mixed with monofunctional organophosphorus compounds are presented. 2 figures, 2 tables.

61836 **Recommendation for combining the standard analytical methods for the determinations of formaldehyde and total aldehydes in air.** Miksch, R.R.; Anthon, D.W. (Lawrence Berkeley Lab., CA). *American Industrial Hygiene Association Journal;* **43**: No. 6, 362-365(May 1982).

For determining formaldehyde, the Intersociety Committee of the American Public Health Association recommends a method using chromotropic acid (CA), and for determining total aliphatic aldehydes a method using 3-methyl-2-benzothiazolone hydrazone (MBTH). In field studies, the use of these separate methods involves performing many tasks in parallel and in duplicate. Inspection of the chemistry underlying the MBTH method suggested that the CA method might be successfully applied to MBTH-containing samples, provided that MBTH did not act as an interferent. We applied the recommended CA method to water and 0.05% MBTH impinger solutions from parallel sampling trains at six field sites, and found the mean formaldehyde levels to differ on the average by 5%. Having established that a single MBTH sample can yield both the formaldehyde and total aliphatic aldehyde contents of a sampled atmosphere we devised a combined method with improved techniques that streamlined laboratory analysis by maximizing procedural overlap.

61837 **Elemental and isotopic analysis of solutions by mass spectrometry using a plasma ion source.** Houk, R.S.; Thompson, J.J. (Iowa State Univ., Ames). *American Mineralogist;* **67**: No. 3-4, 238-243(Mar 1982). Contract W-7405-ENG-82.

Solution aerosols are introduced into an atmospheric pressure inert gas plasma where elemental constituents are ionized. An ion sampling interface extracts gas from the plasma into a vacuum system where the ions are mass anayzed and detected. The feasibility of this analytical concept for trace elemental and isotopic analysis was first demonstrated using a capillary arc plasma. Recent work is described which was performed with an inductively coupled plasma. The relative standard deviations obtained for determination of relative abundances of Cu and Rb isotopes are approximately +/-1 percent. Samples are directly inroduced into the plasma ionization source and can be changed in approximately two minutes by simple procedures performed completely outside the vacuum system. Dissolution and nebulization are the only sample preparation procedures required. Ions from most of the elements studied are obtained under the same operating parameters. Continued improvements in ion extraction techniques are expected to make plasma ion sources valuable for rapid mass spectrometric analysis of solutions.

61838 **Nitric acid measurement methods: an intercomparison.** Spicer, C.W. (Battelle Columbus Lab., OH); Howes, J.E. Jr.; Bishop, T.A.; Arnold, L.H.; Stevens, R.K. *Atmospheric Environment;* **16**: No. 6, 1487-1500(1982).

An interlaboratory comparison of methods to measure gaseous nitric acid is described. Field experiments were conducted in Claremont, CA in late August and early September of 1979. Ten nitric acid measurement methods were compared during the 8 day field experiment. Six different research groups participated in the nitric acid measurements. The methods compared include 2 which employed chemiluminescence principles, 1 infrared, 2 diffusion denuder and 5 filtration techniques. The 8 study days were divided into 32 samplng intervals of 3, 6 and 12 h. Based on the median of the 10 methods, the nitric acid concentration ranged rom 1.85 to 37.05 μgm^{-3}. The nitric acid concentration was highly correlated with other photochemical pollutants such as O_3 and PAN, and all three were strongly correlated with temperature and solar intensity. On the average, gaseous nitric acid and particulate nitrate contributed equally to the total inorganic nitrate burden at the site. Of the 10 methods investigated, 5 exhibited excellent agreement with the median nitric acid concentration, 2 yielded slopes significantly exceeding 1.0 and 3 suffered from problems which resulted in relatively poor agreement with nitric acid concentraion. A great many chemical and meteorlogical variables were measured during the study, and the effects of these ancillary variables on the nitric acid measurement methods are discussed.

61839 **Automated activation analysis system.** Minor, M.M.; Hensley, W.K.; Denton, M.M.; Garcia, S.R. (Los Alamos National Lab., NM (USA)). *Journal of Radioanalytical Chemistry;* **70**: No. 1-2, 459-471(1982).

From 1981 international conference on modern trends in activation analysis; Toronto, Canada (15 - 19 Jun 1981).

An automated delayed neutron counting and instrumental neutron activation analysis system has been developed at Los Alamos National Laboratory's Omega West Reactor (OWR) to analyze samples for uranium and 31 additional elements with a maximum throughput of 400 samples per day. The system and its mode of operation for a large reconnaissance survey will be described.

61840 Chemical characterization of gas- and oil-bearing shales by instrumental neutron activation analysis. Frost, J.K.; Koszykowski, R.F.; Klemm, R.C. (Lawrence Livermore National Lab., CA (USA)). *Journal of Radioanalytical Chemistry;* **71**: No. 1-2, 199-214(1982).

From 1981 international conference on modern trends in activation analysis Pt. 3; Toronto, Canada (15 - 19 Jun 1981).

The concentration of As, Ba, Ca, Co, Cr, Cs, Dy, Eu, Fe, Ga, Hf, K, La, Lu, Mn, Mo, Na, Ni, Rb, Sb, Sc, Se, Sm, Sr, Ta, Tb, Th, U, Yb and Zn were determined by instrumental neutron activation analysis in block shale samples of the New Albany Group (Devonian-Mississipian) in the in the Illinois Basin. Uranium content of the samples was as high as 75 ppm and interfered in the determination of samarium, molybdenum, barium and cerium. In the determination of selenium a correction was made for interference from tantalum. U, As, Co, Mo, Ni and Sb as well as Cu, V and pyritic sulphur which were determined by other methods, were found to correlate positively with the organic carbon content of the samples.

61841 Distribution equilibria of Eu(III) in the system: bis(2-ethylhexyl)phosphoric acid organic diluent-NaCl, lactic acid, polyaminocarboxylic acid, water. Danesi, P.R.; Cianetti, C.; Horwitz, E.P. (Argonne National Lab., IL). *Separation Science and Technology;* **17**: No. 3, 507-519(1982).

The distribution equilibria of Eu^{3+} between aqueous phases containing lactic acid and N'-(2hydroxyethyl)ethylenediamine-N,N,N'-triacetic acid (HEDTA) or diethylenetriamine-N,N,N',N',N''-penetaacetic acid (DTPA) at constant ionic strength (μ = 1.0), and n-dodecane solutions of HDEHP have been studied. The formation constants of the simple Eu-lactate complexes and Eu-lactate-HEDTA mixed complex were evaluated from the k/sub d/ data. The conclusion is reached that no lactic acid is coextracted into the organic phase at tracer metal concentrations. The separation factors between Eu^{3+}, Pm^{3+}, and Am^{3+} have been evaluated in the presence of HEDTA.

61842 (LA-tr—82-27) Method for the determination and analysis of highly active chemical-warfare substance in cloud form. Guers, K.; Seger, G.; Scheichl, L.; Bauer, T. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. Translation of German Patent 1,913,876. 7p. NTIS, PC A02/MF A01. Order Number DE82021913.

A method is disclosed for the determination of highly active chemical warfare substances in cloud form (aerosols of Sarin, Tabun, and VX). The warfare substance cloud is located by nonmonochromatic laser beams and the intensity of the individual reflecting laser lines is evaluated for spectral analysis. (DMC)

61843 Comparison study for determining dissolved boron in natural water and geothermal fluid. Trujillo, P.E.; Gladney, E.; Counce, D.A.; Mroz, E.J.; Perrin, D.R.; Owens, J.W.; Wangen, L.E. (Los Alamos National Lab., NM). *Analytical Letters;* **15**: No. A7, 643-655(1982).

Analytical methods for measuring boron concentrations in geothermal fluid were evaluated. Samples were collected from the Los Alamos Hot Dry Rock Geothermal Energy Project and from natural waters in the vicinity of the project. Three colorimetric techniques, the carmine method and two azomethine H methods, were compared with two plasma emission spectroscopy methods and with thermal neutron capture-gamma spectroscopy. In general, the analytical results from all the methods were comparable and acceptable; however, each method had distinct advantages and disadvantages. 3 tables.

61844 Extracting alcohols from aqueous solutions. Compere, A.L.; Googin, J.M.; Griffith, W.L. (to Dept. of Energy). US Patent Application 326,775. 2 Dec 1981. 24p. Contract W-7405-ENG-26.

Portions of document are illegible.

The objective is to provide an efficient process for extracting alcohols in aqueous solutions into hydrocarbon fuel mixtures, such as gasoline, diesel fuel and fuel oil. This is done by contacting an aqueous fermentation liquor with a hydrocarbon or hydrocarbon mixture containing carbon compounds having 5-18 carbon atoms, which may include gasoline, diesel fuel or fuel oil. The hydrocarbon-aqueous alcohol solution is then mixed with one or more of a group of polyoxyalkylene polymers to extract the alcohol into the hydrocarbon fuel-polyoxyalkylene polymer mixture.

61845 Neutron sources for activation analysis of geological materials. Chatt, A. (Dalhousie Univ., Halifax, Nova Scotia (Canada). Dept. of Chemistry); Katz, S.A. (Dept. of Chemistry, Camden College of Arts and Sciences, Rutgers University, camden, N.J. (USA)). pp 43-72 of Neutron activation analysis in the geosciences. Muecke, G.K. (ed.). Toronto, Ontario; Mineralogical Association of Canada (1980).

From Short course in neutron activation in the geosciences; Halifax, Canada (1 May 1980).

The success of neutron activation analysis is frequently determined by the intensity, homogeneity and stability of the neutron flux. Thermal neutron fluxes of10^{12} $n.cm^{-2}.s^{-1}$ are routinely achieved in research reactors, while small accelerators of the Cockroft-Walton type are able to produce fluxes on the order of 10^9 $n.cm^{-2}.s^{-1}$ using the deuterium-tritium fusion reaction. Isotopic neutron sources based upon spontaneous fission, (γ,n) or (d,n) reactions produce fluxes of from 10^3 to 10^6 $n.cm^{-2}.s^{-1}$. The reactor, the accelerator and isotope sources each have advantages and disadvantages, and each has been used successfully in the analysis of geologic materials.

61846 Instrumentation in neutron activation analysis. Jagam, P.; Muecke, G.K. (Dalhousie Univ., Halifax, Nova Scotia (Canada). Dept. of Geology). pp 73-108 of Neutron activation analysis in the geosciences. Muecke, G.K. (ed.). Toronto, Ontario; Mineralogical Association of Canada (1980).

From Short course in neutron activation in the geosciences; Halifax, Canada (1 May 1980).

The rise of neutron activation analysis (NAA) as a tool in geochemical research has parallelled advances in detector, multichannel analyzer, and computer technology. Micro-computers are now being integrated into NAA systems, and gamma-ray spectrometer instrumentation is evolving towards direct-reading systems. The investigator is faced with a wide range of possibilities and choices when equipping or re-equipping a laboratory. The geoscientist is provided with an overview of the available instrumentation and what soon may be feasible.

61847 Application of NAA to environmental studies. Jervis, R.E. (Toronto Univ., Ontario (Canada). Dept. of Chemical Engineering and Applied Chemistry). pp 255-279 of Neutron activation analysis in the geosciences. Muecke, G.K. (ed.). Toronto, Ontario; Mineralogical Association of Canada (1980).

From Short course in neutron activation in the geosciences; Halifax, Canada (1 May 1980).

Nuclear activation techniques are well suited to the measurment of environmental contaminants and to the elucidation of the sources, dispersion, and fate of such pollutants. Both the nondestructive instrumental activation analysis technique and radiochemical separations are used regularly; a less frequently employed procedure is the technique of tracing through activable elements deliberately added to a system. Special features of activation techniques when applied to the environment include the capability of detecting most elements at parts-per-million or -billion levels; the use of instrumental techniques which avoid the need for sample dissolution; the versatility they offer in terms of the sample matrix; the ability to focus on a single element without regard to the other elements present; and the ability to detect a wide range of trace elements simultaneously.

61848 Analysis of airborne particles by physical methods. Malissa, H. (ed.). West Palm Beach, FL; CRC Press, Inc. (1978). 311p.

This monograph presents the analytical possibilities of characterizing airborne particles utilizing mainly physical methods. Initially, there is a description of the situation that confronts the analytical chemist and a definition of the goals of analysis. The different techniques for sampling particulate matter are then presented. After sampling, the analytical task involves obtaining information concerning the average content of the elements in the dust sample

or the air. X-ray fluorescence, atomic emission and absorption spectroscopy, radioactivity measurements, spark source mass spectrometry and neutron activation analysis are discussed regarding their application to this particular task. A primary concern of integrated dust analysis is the identification and determination of the chemical species. Obtaining this information via the analysis of individual particles (which also includes characterization by size, shape, and morphology) with the various techniques of local analysis is discussed as is the use of techniques that directly yield compound specific information like electron spectroscopy, ir-spectroscopy or thermoanalysis. Questions concerning the development and choice of suitable standard reference materials are treated. The final chapter deals with monitoring atmospheric pollution.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 60748, 60767, 60851, 61039, 61040, 61857, 61868

61849 (DESY-SR—81/06) Kr and Xe guest atoms in Ar matrix: emission spectra, excitation spectra, and lifetimes. Hahn, U.; Haensel, R.; Schwentner, N. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Sep 1981. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82906229.

Portions of document are illegible.

Emission bands of isolated Kr and Xe atoms in solid Ar matrices are assigned to atomic $^3P_1$ and $^1P_1$ states on the basis of excitation and emission spectra. The temperature and concentration dependence of these spectra is used to sort out emission from distorted sites. The dependence of the lifetimes on temperature reflects the competition between radiative and nonradiative decay.

61850 (DOE/ER/05226—1) Study of catalysts and mechanisms in synthesis reactions. Lunsford, J.H. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 19 Aug 1982. Contract AS05-76ER05226. 5p. NTIS, PC A02/MF A01. Order Number DE82021942.

As reported previously, the synthesis of methanol from CO and H_2 occurs over supported palladium; however, it has been observed that the selectivity and activity of the catalysts are highly dependent upon the nature of the support. Over Pd on Davison grade 57 gel almost 100% selectivity to methanol was observed; whereas, over Pd on grade 01 gel almost 100% selectivity to methane was observed, with the latter catalyst being much less active than the former. Research has also continued on the water gas shift reaction ($CO + H_2O \rightarrow CH_3 + CO_2$) over supported rhodium and ruthenium. This work is now completed, and the results show that the reaction probably occurs over supported ruthenium by a molecular mechanism; i.e., without dissociation of CO. Formation of 1-methylallyl radicals was observed during the partial oxidation of 1-butene over Bi_2O_3. The catalytic activity for allylic hydrogen abstraction and the rate-determining step were controlled by the degree of reduction of the catalyst surface. By contrast, over bismuth molybdate the radicals do not leave the surface before abstraction of a second hydrogen atom, and 1,3-butadiene is the only product. Research on the activation of methane has resulted in a study of methyl radical formation over several oxides. Unlike the case with propylene and butene, Bi_2O_3 is not capable of abstracting hydrogen from methane; however, MgO is quite effective when N_2O is used as an oxidant.

61851 (DOE/EV/03018—T6) Luminescence studies: luminescence of aqueous ionic solutions; temperature dependence of the phosphorescence of phenanthene in ethanol - effects of gases. Mathers, T.L. (Louisiana State Univ., Baton Rouge (USA). Dept. of Chemistry). May 1982. Contract AS05-76EV03018. 171p. NTIS, PC A08/MF A01. Order Number DE82020347.

Thesis.

I. The anomolous luminescence of aqueous solutions of I^-, Br^-, OH^-, etc. is characteristic of the solvent. The emission of a KBr solution is greatly reduced by purification of the KBr; however, this emission reappears upon addition of acids. This luminescence is postulated to be due to the recombination of H_3O^+ and e^-. Hydroxide and hydrosulfide may be from transferring a hydrogen atom to the water. The hydronium radical and the triplet state of water are discussed. Neither can account for the luminescence; however, an excited state complex between water and a H atom may be involved. II. Effects of gases on the temperature dependences of the phosphorescence of phenanthrene in ethanol are studied. Both the glass transition region and crystal formation region for ethanol are shifted when O_2 or N_2 is added. Other nonpolar gases (Ar and ethane) do not exhibit this shift. The effect for O_2 and N_2 is explained by invoking hydrogen bond breaking, which also affects the denaturation of DNA. 22 figures, 9 tables.

61852 (LBL—14598) Non-rigid molecular group theory and its applications. Balasubramanian, K. (Lawrence Berkeley Lab., CA (USA)). Jun 1982. Contract AC03-76SF00098. 20p. (CONF-8206112—1). NTIS, PC A02/MF A01. Order Number DE82020518.

From Conference on symmetries and properties of non-rigid molecules; Paris, France (30 Jun 1982).

The use of generalized wreath product groups as representations of symmetry groups of nonrigid molecules is considered. Generating function techniques are outlined for nuclear spin statistics and character tables of the symmetry groups of nonrigid molecules. Several applications of nonrigid molecular group theory to NMR spectroscopy, rovibronic splitting and nuclear spin statistics of nonrigid molecules, molecular beam deflection and electric resonance experiments of weakly bound Van der Waal complexes, isomerization processes, configuration interaction calculations and the symmetry of crystals with structural distortions are described. 81 references.

61853 (LBL—14705) Relativistic calculations of dissociation energies and related properties. Pitzer, K.S. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 33p. (CONF-8206111—1). NTIS, PC A03/MF A01. Order Number DE82020541.

From Symposium on relativistic effects in quantum chemistry; Abo Akademi, Finland (21 Jun 1982).

Methods of calculation of potential energy curves or surfaces, including dissociation energies, bond distances, and vibration frequencies, are discussed as well as recently obtained results for several molecules. The ab initio relativistic methods involve the derivation of shape-consistent effective potentials from Dirac-Fock atomic calculations. These effective potentials are averaged and differenced with respect to spin with the differences, p/sub 3/2/ - p/sub 1/2/, etc., yielding spin-orbit operators. The molecular calculations are then set up in a familiar manner through the SCF stage using spin-averaged effective potentials. The final stage is a configuration interaction calculation including the spin-orbit terms as well as the electron repulsion terms. Calculations which have been made for several low-lying excited states as well as the ground state for Au_2, TlH, Tl_2, Sn_2, and Pb_2 are reviewed. Good agreement is obtained with spectroscopic data and a number of interesting predictions are made. 8 figures, 2 tables.

61854 (MLM—2992-OP) Separation of selected stable isotopes by liquid-phase thermal diffusion and by chemical exchange. Rutherford, W.M.; Jepson, B.E.; Michaels, E.D. (Monsanto Research Corp., Miamisburg, OH (USA). Mound Facility). 1982. Contract AC04-76DP00053. 20p. (CONF-820909—9). D. Order Number DE82021348.

From National meeting of the American Chemical Society; Kansas City, MO, USA (1 Sep 1982).

Portions of document are illegible.

Useful applications of enriched stable nuclides are unduly restricted by high cost and limited availability. Recent research on liquid phase thermal diffusion (LTD) has resulted in practical processes for separating ^{34}S, ^{35}Cl, and ^{37}Cl in significant quantities (100 to 500 g/yr) at costs much lower than those associated with the electromagnetic (Calutron) process. The separation of the isotopes of bromine by LTD is now in progress and ^{79}Br is being produced in relatively simple equivalent at a rate on the order of 0.5 g/day. The results of recent measurements show that the isotopes of Zn can be separated by LTD of zinc alkyls. The isotopes of calcium can be separated by LTD and by chemical exchange. The LTD process is based on the use of aqueous $Ca(NO_3)_2$ as a working fluid. The chemical exchange method involves isotopically selective ex-

change between an aqueous phase containing a calcium salt and an organic phase containing calcium in the form of a complex with a macrocyclic ligand. The LTD method is suitable for high enrichments at low through-puts; whereas, the chemical exchange techniques is appropriate for lower enrichments at much higher production rates. Current research is directed toward reducing these concepts to practical processes.

61855 **Thermal desorption of argon and neon from solid xenon. I. Transition state theory rate constants.** Adams, J.E.; Doll, J.D. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* 77: No. 6, 2964-2967(15 Sep 1982).

Rate constants for thermal desorption of physisorbed argon and neon from a xenon(111) crystal face have been calculated using a generalization of Slater's unimolecular reaction rate theory, with a particular emphasis being placed on an investigation of the dependence of these rates upon the degree of surface coverage and upon the lattice motion of the solid. For argon our Monte Carlo results show a non-negligible coupling between adatom dynamics and the thermal vibration of the crystal surface which leads roughly to a 20% enhancement of the desorption rate. The increase is, however, only half as great for neon, with a static-solid description becoming appropriate as the system temperature is decreased. The adatom concentration effect on the kinetics also appears to be more dramatic for adsorbed argon than for neon, presumably as a consequence of the longer range and greater strength of the argon—argon potential.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 60748, 60767, 61073, 61851, 61864, 61868, 61872, 62233

61856 **(DOE/ER/10554—22) Analytical and physicochemical studies of non-electrolyte solutions.** Chien, C.J. (Ohio State Univ. Research Foundation, Columbus (USA). Dept. of Chemistry). Aug 1982. Contract AC02-80ER10554. 271p. NTIS, PC A12/MF A01. Order Number DE82020759.

Thesis. Portions of document are illegible.

High-precision gas-liquid chromatographic studies of N,N-dibutyl-2-ethylhexylamide (DBEHA), n-hexadecyl iodide, and 4-n-pentyl-4'-cyanobiphenyl (PCB) were carried out on the neat form and dissolved in n-hexadecane, n-octadecane, and tetra-n-butyltin. The microscopic partition hypothesis did not describe the behavior of these solvent mixtures. Conventional solutions theories failed to describe the experimental data derived from the DBEHA (haloalkane solutes) and nematic-phase PCB solvent systems. Complexation studies of N,N-dialkylamides (N,N-dimethyl formamide, N,N-dimethyl acetamide, and N,N-dimethyl thioformamide) by NMR showed that mixtures of these species with C_6H_6 or CCl_4 could not be described by simple equations. The window diagram strategy was successful for several solvents with packed columns of mixed-bed stationary phases. For intimate mixtures of phases (packed columns and glass-capillary columns), highly-ordered liquid crystals (nematic as well as isotropic regions) gave relative retentions for inert solutes (e.g., alkanes) different from highly-polarizable solutes (e.g., aromatics). Relative retentions with mixtures of solvents other than liquid crystals, in contrast, are expected to be predictable for purposes of application of the window diagram strategy. Replication of solute retentions with mixed-bed packed columns as well as with a capillary column containing an in-situ polymerized stationary phase were found to conform nearly exactly to one equation and its variants. 44 figures, 84 tables.

61857 **(DOE/ER/10612—8) Stable-isotope studies. Progress report, March 1, 1980-August 25, 1982.** Ishida, T. (State Univ. of New York, Stony Brook (USA). Dept. of Chemistry). 25 Aug 1982. Contract AC02-80ER10612. 183p. NTIS, PC A09/MF A01. Order Number DE82020962.

Portions of document are illegible.

Investigations during the past two-and-a half year priod have been directed toward the following three areas: (1) studies of vapor pressure isotope effects (fluoroform, methyl fluoride, methylene difluorides, ammonia); (2) studies on the fractionation of nitrogen isotope systems; and (3) theory of isotope effect. Studies on the fractionation of nitrogen isotope fractionaton systems involved two fronts. One is a study of ^{15}N-production by means of a countercurrent isotope exchange in a packed column between a gas phase, which is a mixture of various NO/sub x/, and a liquid phase, which is mainly N_2O_3 and N_2O_4. The second deals with a concept of closed reflux cycle for the Nitrox and/or the NO/N_2O_3-process. In the theoretical field, studies of isotopic reduced partition function ratio has led to revelations of interesting correlations between molecular structures, molecular forces, and the isotope effects. The investigations for this period are summarized and a more thorough discussion is presented for each ongoing research. (ATT)

61858 **(PB—82-200627) Phase equilibrium studies for methane/synthesis gas separation: the hydrogen-carbon monoxide-methane system.** Hong, J.H.; Kobayashi, R. (Gas Processors Association, Tulsa, OK (USA)). Apr 1982. 34p. (RR—55). NTIS, PC A03/MF A01.

This experimental study completes an extensive investigation of vapor-liquid equilibria for hydrogen-carbon monoxide-methane ternary system and associated binaries. The composite data are of particular benefit to the supplemental gas industry, wherein the separation of product methane from recycle gas is of major importance. Although the data may find direct application, the broader intent of this experimental effort is to provide a reliable data base from which accurate equilibria prediction models may be developed.

61859 **Study of the unimolecular decomposition of the $(C_2H_2)_2^+$ complex.** Ono, Y.; Ng, C.Y. (Ames Laboratory, U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* 77: No. 6, 2947-2955(15 Sep 1982).

The internal energy effects and the energetics of the ion—molecule reactions $C_2H_3^+ + C_2H_2 \rightarrow C_4H_3^+ + H$, $C_4H_2^+ + H_2$, and $C_4H_2^+ + 2H$ have been studied by photoionization of neutral van der Waals acetylene dimers. The appearance energies for $C_4H_3^+$ and $C_4H_3^+$ from $(C_2H_2)_2$ were found to be identical and have the value of 10.90 +- 0.05 eV (1137 +- 5 A). These measurements suggest activation energies of ~0 and ~12 kcal/mol for the $C_4H_3^+ + H$ and the $C_4H_2^+ + H_2$ channels, respectively. The ratio of the fragmentation probabilities for the formation of $C_4H_3^+ + H_2$ and $C_4H_3^+ + H$ from $C_2H_2^+$(X ^{2}Pi/sub u/,v) x C_2H_2 was found to decrease from approximately 0.70 to 0.45 as the ionization photon energy was increased from the ionization threshold of C_2H_2 (11.40) to ~14.60 eV. The energy dependence measurements for the relative fragmentation probabilities of $C_4H_2^+$ and $C_4H_3^+$ from $(C_2H_2)_2^+$ support the conclusions that the $C_4H_3^+$ ions fragment further to form $C_4H_2^+ + H$ with little kinetic shift effects and that the $C_4H_3^+ + 2H$ channel is mainly responsible for the substantial increase in the intensity of $C_4H_3^+$. Evidence was found that the high vibrationally excited levels of the X ^{2}Pi/sub u/ state are as effective as the A $^2\Sigma$/sub g/$^+$ state in the formation of $C_4H_3^+ + 2H$ provided the reaction is energetically allowed. Solvation does not affect the fragmentation probabilities at energies below the thermochemical threshold (~14.93 eV) for the $C_4H_3^+ + 2H$ channel, whereas at energies higher than 14.93 eV the association of additional acetylene molecules to dimer ions will strongly favor the $C_4H_3^+ + H$ formation at the expense of the $C_4H_2^+ + 2H$ channel.

61860 **Synthesis of 15-(p-iodophenyl)-6-tellurapentadecanoic acid: a new myocardial imaging agent.** Goodman, M.M.; Knapp, F.F. Jr. (Oak Ridge National Lab., TN). *Journal of Organic Chemistry;* 47: No. 15, 3004-3006(16 Jul 1982). Contract W-7405-ENG-26.

1-Cl-9-(p-iodophenyl)nonane was coupled with sodium (methylvaleryl) telluride to produce methyl-15-(p-iodophenyl)-6-tellurapentadecanoate in 90% yield. Hydrolysis produced the title compound. ^{1}HNMR and chromatographic analysis substantiated the structure. This method can be used in the synthesis of other fatty acid analogues. The compound has been prepared with iodine 125 and 131 labels. These agents showed prolonged myocardial retention in rats with little in vivo deiodination.

61861 **Synthesis of peri-substituted naphthalenes and tetralins.** Pourahmady, N.; Vickery, E.H.; Eisenbraun, E.J. (Oklahoma State Univ., Stillwater). *Journal of Organic Chemistry;* 47: No. 13, 2590-2593(18 Jun 1982). Contract AS19-80BC10298.

Synthesis of 1-ethyl-8-methylnaphthalene and 1-isopropyl-8-methylnaphthalene along with several 1,2,3,4-tetrahydro derivatives is described. The difficulties encountered in the synthesis and purification of these peri-substituted hydrocarbpms are discussed.

4005 Photochemistry

REFER ALSO TO CITATION(S) 61073

61862 **(DOE/ER/10366—4) Sensitization and quenching in the conversion of light energy into chemical energy. Annual progress report, February 1, 1982-January 31, 1983.** Cristol, S.J. (Colorado Univ., Boulder (USA)). Aug 1982. Contract AC02-79ER10366. 11p. NTIS, PC A02/MF A01. Order Number DE82021592.

Work has been completed on the photorearrangements of several dibenzobarrelenes to dibenzocyclooctatetraenes (singlet reactions), the quenching of that process, and the accompanying sensitization to give dibenzosemibullvalenes, as mediated by acetone concentration. This work has demonstrated, apparently for the first time, the plausibility of a relay mechanism in which an excited singlet of a reactant, produced by direct irradiation, is quenched, the quencher intersystem crosses to its triplet state and then retransfers energy to the reactant molecule to give its triplet, which does its own chemistry. Work aimed at determining substituent effects on excited-state reaction-rate constants and reactivities has been continued. Work on excitation transfer geometry and on oxidation potential requirements in excited bichromophoric molecules is in progress or in prospect, as is work on lifetime measurements of certain excited singlet and triplet states.

61863 **(DOE/ET/26957—T1) Hydrocarbon entrapment of light energy of the sun. Final report, September 30, 1977-September 29, 1978.** Mariano, P.S.; Rose, T.L. (Texas A and M Univ., College Station (USA). Research Foundation). 1979. Contract FG05-77ET26957. 42p. NTIS, PC A03/MF A01. Order Number DE82020463.

Studies conducted during the grant period concentrated on two aspects of the problems proposed for investigation. First strategies for selection of organic systems of potential utility in solar energy storage and conversion methodologies were outlined. Several criteria for judging the solar to thermal energy conversion efficiency, energy storage capacity, and quality of retrievable heat were developed for systems operating on the basis of the reversible cyclie A reversible B, in which the forward reaction (A → B) is given photochemically and the reverse (B → A) using catalysts. The criteria established to evaluate these systems have been applied to the familiar norbornadiene - quadricyclene cycle. The second phase of the investigation conducted during the project period has involved laboratory experiments on a new class of potentially important energy storing photoreactions involving the reversible isomerization of 1-substituted-2-pyridones. These materials undergo electrocyclic closure upon irradiation to produce the kinetically stable Dewarpyridones. Several of the other important features of this system which appears to make it ideally suited for application in solar energy storage and conversion technologies are outlined. In addition, the results of our initial exploratory efforts on these compounds are summarized. Studies demonstrated that simple 2-pyridones possessing vinyl substituents on nitrogen have alternate excited state reaction pathways available leading to the production of oxazolopyridinium yields. A complete kinetic analysis of these processes as well as a survey of solvent polarity and substituent effects of reaction efficiencies have been performed and are outlined.

61864 **(DOE/EV/03018—T5) Spectroscopy and photochemistry of aromatic and cyclic β-diketones.** Pascal H, F.A. (Louisiana State Univ., Baton Rouge (USA)). Aug 1982. Contract AS05-76EV03018. 203p. NTIS, PC A10/MF A01. Order Number DE82019298.

Thesis.

β-Diketones exist in a tautomeric equilibrium between the enol and the keto forms. The enol form is the most stable because of the formation of an intramolecular hydrogen bond. β-Diketones in solution at 77°K exhibit changes in their absorption and phosphorescence spectra upon irradiation with a powerful uv-visible source. The changes observed in the molecule result from rupture of the intramolecular hydrogen bond. Once the hydrogen bond has been broken a distribution of conformers of the enol is possible. The formation of a negative ion can also result from the irradiation and a distribution of conformers of the negative ion is also possible. CNDO/S-2 calculations on aromatic β-diketones have been done in order to help understand the spectroscopy of these compounds. Cyclic β-diketones have also been investigated. The form which predominates is dependent upon the size of the ring (strain). The formation of an intramolecular hydrogen bond in some cyclic β-diketones is not possible. The absorption spectra of these diketones is not possible. The absorption spectra of these diketones in alcoholic, hydrocarbon, acid and basic solvent have been investigated. Two phosphorescences from these compounds are observed when they are in solution at 77°K. Some of the observed luminescences are attributed to the dissociated enolic form. 43 figures, 16 tables.

61865 **Effect of pulse intensity distributions on fragment internal energy in the infrared multiphoton dissociation of vinyl cyanide.** McKillop, J.S.; Gordon, R.J.; Zare, R.N. (Department of Chemistry, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* 77: No. 6, 2895-2901(15 Sep 1982).

A plasma shutter has been used to remove the less intense tail of a CO_2 laser pulse without otherwise altering the pulse characteristics. It is found that variations in the pulse intensity distribution control the rotational distribution of CN fragments formed in the IR photolysis of vinyl cyanide $H_2C = CHCN$.

4006 Radiation Chemistry

61866 **(DOE/ER/02968—143) Studies of radiation-produced radicals and radical ions. Progress report, June 1, 1981-August 31, 1982.** Williams, T.F. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1982. Contract AS05-76ER02968. 43p. NTIS, PC A03/MF A01. Order Number DE82021223.

The discovery and characterization of novel radical ions produced by the γ irradiation of solids continues to be a fertile field for investigation. This Progress Report describes the generation and ESR identification of several new paramagnetic species, some of which have long been sought as important intermediates in radiation chemistry. We have also contributed to a general theoretical problem in ESR spectroscopy. Solid-state studies of electron attachment reactions, both non-dissociative and dissociative, reveal interesting structural and chemical information about the molecular nature of these processes for simple compounds. In particular, ESR measurements of the spin distribution in the products allow a fairly sharp distinction to be drawn between radical anions and radical-anion pairs or adducts. Dimer radical anion formation can also take place but the crystal structure plays a role in this process, as expected. Some radical anions undergo photolysis to give radical-anion pairs which may then revert back to the original radical anion by a thermal reaction. The chemistry of these reversible processes is made more intricate by a competing reaction in which the radical abstracts a hydrogen atom from a neighboring molecule. However, the unraveling of this complication has also served to extend our knowledge of the role of quantum tunneling in chemical reactions. The results of this investigation testify to the potential of solid-state techniques for the study of novel and frangible radical ions. Progress in this field shows no sign of abating, as witness the recent discovery of perfluorocycloalkane radical anions and alkane radical cations.

61867 (INIS-SU—29, pp vp) **Radiation facility for vulcanization of synthetic leather and rubbers.** Usanova, A.V.; Burov, V.K.; Vanyushkin, B.M.; Kon'kov, N.G.; Panin, Yu.A. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Radiation technology.

Advisability of applying γ-radiation rubber technical products is considered. Advantages and shortcomings of using installations with γ-sources and electron accelerators in fabrication of rubber technical products are pointed out. Specifications are given, design and performance of specially developed pilot-plant equipment for vulcanization of synthetic leather and rubbers with ELV-2 electron accelerator, are described. The equipment permits to carry out and optimize the process of radiation vulcanization in a continuous regime in a general processing line.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 60986, 60988, 60989, 61009

61868 **(DOE/ER/01797—99) Research in nuclear chemistry. Progress report, March 1, 1982-February 28, 1983.** Choppin, G.R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1982. Contract AS05-76ER01797. 29p. (ORO—1797-99). NTIS, PC A03/MF A01. Order Number DE82021932.

Portions of document are illegible.

Investigation of the complexation and redox behavior of actinides in aqueous solution remained the principle goal of this research. Analogous and complementary studies of lanthanides were conducted simultaneously. Associated studies on separation methods, a specific ion electrode, etc. were designed to further the primary goal of fuller understanding of actinide behavior in aqueous solutions. The influence of ligand pK/sub a/ and cation charge density on the relative degree of inner vs outer sphere complexation was shown through studies of actinide complexation by halate and haloacetate ligands. Complexation studies with benzoate, m-phthalate, MEDTA, EDTDA and ENTMP investigated the effect of ligand charge transfer, chelate ring size and phosphonate vs carboxylate binding. Binding to AMP and ATP was interpreted as due to metal-phsophate attraction with no metal-adenosine interaction. Synthetic polymeric carboxylates were used as models for the natural polyelectrolyte humic acid in investigation of actinide-polyelectrolyte interaction. Pu (VI) was bound strongly by humic acid and reduced to either Pu (V) or Pu (IV). A coated wire ion specific electrode was developed for actinyl (VI) cations and found to be reversible, reproducible and selective over the pH range of 2 to 5 and AnO_2^{+2} range of 10^{-5} to 10^{-2} M. The reduction of NpO_2^{+2} to NpO_2^{+} by a variety of organic ligands was tested. As a result the reduction by several families of ligands (e.g., alkyldicarboxylic acids) is being studied in some detail. Calorimetric study of the thermodynamics of the synergistic reaction of actinides with TTA + TBP in wet and anhydrous toluene is providing fuller understanding of the role of dehydration and/or expansion of the metal coordination sphere in synergism. 8 figures, 2 tables.

61869 **(DOE/EV/10363—3) Progress report on nuclear medicine, March 1, 1982-February 28, 1983.** Kabalka, G.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1983. Contract AS05-80EV10363. 6p. NTIS, PC A02/MF A01. Order Number DE82021357.

Highlights of progress achieved during the year ending February 28, 1983, are summarized. The long-range objective is to develop new rapid methods for the introduction of short-lived radionuclides into agents for use in diagnostic nuclear medicine. Methods have been developed to synthesize a radioiodine labeled fatty acid and a radioiodine labeled steroid. New methods have also been developed for introducing nitrogen isotopes into physiologically active materials and for the introduction of radiobromine into physiologically active materials.

61870 **(DOE/EV/10363—4) Comprehensive report on nuclear medicine, March 1, 1980-February 28, 1983.** Kabalka, G.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1983. Contract AS05-80EV10363. 18p. NTIS, PC A02/MF A01. Order Number DE82021355.

The long-range objective is to develop new rapid methods for the introduction of short-lived radionuclides into agents for use in diagnostic nuclear medicine. During the initial three-year period, syntheses of radioiodine-labeled ω-iodo-fatty acids and radioiodine-labeled estradiol derivatives were accomplished. Furthermore, synthetic routes to nitrogen-13-labeled amines were investigated. The synthetic routes involved organoborane intermediates which produce good yields of high-specific-activity radiolabeled products in reasonable reaction times. In addition, the incorporation of other nuclides (Cl, F, Br, O, and C) which have medically important isotopes was investigated. Results of the 3-year study are summarized.

61871 **(ORNL/TM—8363) Nuclear-medicine progress report for quarter ending March 31, 1982.** Knapp, F.F. Jr.; Ambrose, K.R.; Butler, T.A.; Goodman, M.M.; Hoeschele, J.D.; Srivastava, P.C. (Oak Ridge National Lab., TN (USA)). Aug 1982. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01. Order Number DE82020474.

The synthesis of a radioiodinated vinyl barbituric acid analog as a potential cerebral perfusion agent is reported. The ^{125}I-labeled barbiturate will be evaluated in rats. In order to evaluate the myocardial uptake and retention of methyl-branched fatty acids, racemic 14-(p-[^{125}I]iodophenyl)-2-(R,S)-methyl-tetradecanoic acid and 15-(p-[^{125}I]iodophenyl)-3-(R,S)-methyl-pentadecanoic acid were prepared by a new route in which methyl branching was introduced by a unique oxazoline intermediate. The branched fatty acids were evaluated in rats and showed good heart uptake, but blood levels were high. Future studies will be directed at resolution of the isomers and evaluation of the R- and S-agents in rats. Eight shipments of ^{191}Os-potassium osmate were made to Medical Cooperative investigators for preparation of the ^{191}Os-/sup 191m/Ir generator to carry out radionuclide angiography with /sup 191m/Ir, and several shipments of /sup 195m/Pt-labeled cis-dichlorodiammineplatinum-(II) (cis-DDP) were supplied to collaborators for evaluation of its antitumor and pharmacologic properties. A variety of structurally modified ^{125}I- and /sup 123m/Te-labeled fatty acid analogs developed in the Nuclear Medicine program were supplied to the Massachusetts General Hospital for further evaluation, including imaging studies and measurement of the myocardial extraction properties in dogs, and tin-117m was supplied to collaborators for preparation of several agents for evaluation of its potential therapeutic use for bone disease. (ERB)

61872 **Solid-phase exchange radioiodination of aryl iodides. Facilitation by ammonium sulfate.** Mangner, T.J.; Wu, J.L.; Wieland, D.M. (Univ. of Michigan Medical Center, Ann Arbor). *Journal of Organic Chemistry;* **47**: No. 8, 1484-1488(9 Apr 1982). Contract AC02-76EV02031.

A mild and simple technique for the synthesis of aryl radioiodides of high specific activity involving a solid-phase exchange between no-carrier-added radioiodide and unactivated aryl iodides is described. Mildly acidic, oxidizing conditions, provided by the in situ thermal decomposition of ammonium sulfate, appear to be necessary for the success of the exchange. Typical isolated radiochemical yields of >70% have been obtained for a variety of aryl iodides, including various aralkyl amines, guanidines, carboxylic acids, and amino acids. Specific activities of up to 100 Ci/mmol of our model compound, (m-[^{125}I]iodobenzyl)guanidine, have been achieved. Preliminary experiments suggest that, with this technique interhalogen exchange of aryl bromides with radioiodine is a feasible approach to the preparation of no-carrier-added aryl radioiodides.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

61873 **(SAND—82-8227) Fundamental combustion and diagnostics research at Sandia. Progress report, January-March 1982.** Gusinow, M.A. (ed.). (Sandia National Labs., Livermore, CA (USA)). Jun 1982. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01. Order Number DE82019996.

Progress is reported in studies which have the potential to impact practical combustion. Included here are quarterly reports on the research sponsored by the Division of Chemical Sciences/Fundamental Interactions Branch. The first section presents progress in fundamental chemistry and modeling, the second section details research on flames, the third section describes results in diagnostics research, and the fourth section provides technical highlights on resources developed and made available to users at the Combustion Research Facility.

42 ENGINEERING

4201 General Engineering

61874 (DOE/DP/00789—T7) Engineering drawing system. (Sandia National Labs., Albuquerque, NM (USA)). May 1978. Contract AC04-76DP00789. 528p. NTIS, PC A23/MF A01. Order Number DE82021981.

Portions of document are illegible.

The purpose of this drawing system manual is to represent the standard practices and information required in the preparation of engineering drawings. The contents include three sections. The first, basic drawing requirements, deals with style, format, dimensioning, etc. The second has instructions for specific types of drawings, e.g., assemblies and parts drawings, electrical and electronic diagrams, gears, and mechanical joints. The third section has reference data on surface treatments, sheet metal working, fasteners, holes, knurling, symbols, abbreviations, and miscellaneous tables. (LCL)

61875 (LALP—82-18) Engineering Sciences Directorate Division profiles. Perkins, R.B.; Morse, N.R.; Tape, J.W. (comps.). (Los Alamos National Lab., NM (USA)). Spr 1982. Contract W-7405-ENG-36. 77p. NTIS, PC A05/MF A01. Order Number DE82021166.

Portions of document are illegible.

The mission of the Engineering Sciences (ES) Directorate of the Los Alamos National Laboratory is developing and maintaining the engineering sciences resources needed to perform Laboratory programs and to establish expertise in new scientific, engineering, and technical areas of interest to the Laboratory. Accomplishing this mission, often requires engineering for unusual materials, for extreme conditions, and for exceptionally complex systems. The seven ES Divisions, which are responsible for accomplishing the Directorate's mission are: computing; controlled thermonuclear research; electronics; dynamic testing; energy; analysis and assessment; and design engineering. This document contains profiles of each ES Division. Its primary purpose is to aid internal planning by providing a clear summary of each Division's resources, activities, and past accomplishments. In particular, each Division profile includes: a statement of its mission; recent significant accomplishments; an organization chart; a computer-generated profile of personnel showing the education/degree distribution with average age for all employees; and the discipline distribution and average age for staff members; totals for various job categories; and computer-generated graphs showing the age distribution for TEC series, staff members, GEN series, and ASMs.

61876 (NP—2906068) Annual research summary, July 1, 1981-June 30, 1982. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). 1982. 183p. Purdue Univ., School of Electrical Engineering, West Lafayette, IN 47907.

This document summarizes the research activities within the School of Electrical Engineering of Purdue University. It is intended as a reference document for colleagues, prospective graduate students and organizations interested in electrical engineering research. The research summaries are organized according to ten areas, the first eight of which the Purdue electrical engineering graduate program is divided for administrative purposes. The ten areas are: automatic controls; bioengineering; circuits and systems; communications; computers and automata; electromagnetic fields and quantum electronics; energy sources and systems; solid state devices and materials; and engineering education.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 60805, 60962, 61251, 61311, 61586, 61685, 61727, 61903, 61923, 61958

61877 (AD-A—112622/6) Prototype low temperature low power cryocooler. Pierce, W.G. (Lake Shore Cryotronics, Inc., Westerville, OH (USA)). Feb 1982. 56p. NTIS, PC A04/MF A01.

Over the past several years considerable interest has developed for low power, low cost mechanical cryocoolers for use in cooling SQUIDS and other superconducting devices. In 1977 Dr. Jim Zimmerman of National Bureau of Standards, Boulder, CO described a stirling cycle cryocooler that exhibited the following desirable characteristics: (1) Low input power (approximately 50 watts connected load); (2) Modest cooling capacity at very low temperature; (3) Constructed of non-ferromagnetic materials; and (4) Simple design. Dr. Zimmerman's intent was to demonstrate the feasibility of constructing a simple low power cryocooler capable of cooling an operational SQUID. After several modifications of the original cryocooler, Dr. Zimmerman successfully operated a point-Contact Nb SQUID on a four-stage stirling cycle cryocooler with a mechanical drive power of approximately 15 watts, and a capacity of few milliwatts at less than 9 Kelvin. During this period Lake Shore Cryotronics, Inc. successfully negotiated an exclusive licensing (for the U.S.) agreement with Oxford Instruments Ltd. concerning a simple patented single stage cryocooler utilizing a slide-valve-controlled gas driven displacer drive head, powered by a remote conventional high speed compressor. The lowest temperature achieved was less than 20 Kelvin with the two stage cylinder/displacer operating at a cycle rate of 2Hz, 100 psi inlet (pressure), and 20 psi outlet pressure.

61878 (LBL—14749) Powder-metallurgy-processed A15 Nb_3Al superconducting wires. Hong, J.M. (Lawrence Berkeley Lab., CA (USA)). Jun 1982. Contract AC03-76SF00098. 112p. NTIS, PC A06/MF A01. Order Number DE82022057.

Thesis.

The possibility of the manufacture of superconducting A15 Nb_3Al wires by a powder metallurgy process was explored. A T/sub c/ value of 17 K and overall J/sub c/ value of $> 10^4$ A/cm^2 at 15 teslas and 4.2 K were obtained. The variations of both T/sub c/ and overall J/sub c/ with the temperature and time of the heat treatment employed were investigated. Based on those, a multiple-step heat treatment was proposed and found to be beneficial to both T/sub c/ and overall J/sub c/. It is believed that this resulted from the improvement of the superconducting characteristics within the wire. The variations of the overall J/sub c/ with other processing parameters were also investigated. Based on the results obtained, the importance of the filament thickness of Nb and Al and the Nb-Al interfacial area in determining the critical current density was discussed. Preliminary characterization of the microstructure of the reacted layer within the powder wire was performed using a transmission electron microscope and the result was presented.

61879 (UCRL—85833) Forced-convection heat transfer in a spherical-annulus heat exchanger. Tuft, D.B.; Brandt, H. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA). Dept. of Mechanical Engineering). Apr 1981. Contract W-7405-ENG-48. 37p. (CONF-811101—30). NTIS, PC A03/MF A01. Order Number DE82019109.

From Winter annual meeting of the ASME Technology and Society Division; Washington, DC, USA (15 Nov 1981).

Results are presented of a combined numerical and experimental study of steady forced-convection heat transfer in a spherical annulus heat exchanger with 50°C heated water flowing in an annulus formed by an insulated outer sphere and a 0°C cooled inner sphere. The inner sphere radius is 139.7 mm, the outer sphere radius is 168.3 mm and the radius ratio is 1.2. In the analytical portion, results of numerical calculations of laminar incompressible fluid flow and heat transfer in a spherical annulus are presented. The full transient axisymmetric Navier-Stokes equations in spherical coordinates are solved by an explicit finite-difference solution technique. Steady solutions are obtained by allowing the transient solution to achieve steady state: temperature and heat-flux rate distributions are presented for gap Reynolds numbers from 4.4 to 440. In the experimental portion, measurements of inner sphere heat-flux rate distribution, flow separation angle, annulus fluid temperatures and total heat transfer are made for gap Reynolds numbers from 41 to 1086. The angle of separation along the inner sphere is found to vary as a function of Reynolds number. Measured total Nusselt numbers agree with results reported in the literature to within 2.0% at a gap Reynolds number of 974 and 26.0% at a gap Reynolds

number of 66. It is believed that the numerical analysis is the first solution of the full laminar Navier-Stokes equations for forced-convection heat transfer in a spherical annulus. The computations predict the experimental trends and qualitative aspects of the flow and heat transfer while underpredicting heat-flux rates by a factor of two or more. Also, this is the first experimental study of spherical annulus convective heat transfer in which inner sphere heat-flux distribution has been measured. In addition, this is the first experimental study in which separation angle has been measured by other than visual methods and found to vary as a function of Reynolds number.

61880 **(UCRL—86739) Improved design for dynamically-loaded, threaded interfaces.** Murphy, M.J. (Lawrence Livermore National Lab., CA (USA)). 16 Apr 1982. Contract W-7405-ENG-48. 26p. (CONF-821003—1). NTIS, PC A03/MF A01. Order Number DE82012701.

From Conference on advances and trends in structural and solid mechanics; Washington, DC, USA (4 Oct 1982).

An improved thread design for dynamically-loaded, threaded interfaces is presented. Maximum stress is generally located in the thread relief region or the root of the first thread of a threaded interface under load. Consequently, a non-uniform stress distribution exists throughout the thread. The improved thread design presented in this paper provides for an alternate load path resulting in a uniform stress distribution and elimination of the thread root and relief stress concentration. Whitworth and ACME type threads have been examined using hydrodynamic finite-element analysis techniques. Correlation with experimental results is good. The new thread design has been successfully implemented in the high explosive velocity augmented kinetic energy penetrator.

61881 **Measurements of quantum noise in resistively shunted Josephson junctions.** Koch, R.H.; Van Harlingen, D.J.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720 and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **26**: No. 1, 74-87(1 Jul 1982).

Measurements have been made of the low-frequency spectral density of the voltage noise in current-biased resistively shunted Josephson tunnel junctions under conditions in which the noise mixed down from frequencies near the Josephson frequency (ν/sub J/) to the measurement frequency ($<<\nu$/sub J/) is in the regime hν/sub J/>k/sub B/T. In this limit, quantum corrections to the mixed-down noise are important. The spectral densities measured on junctions with current-voltage characteristics close to the Stewart-McCumber model were in excellent agreement with the predicted values, with no fitted parameters. The mixed-down noise for a wide range of bias voltages was used to infer the spectral density of the current noise in the shunt resistor at frequency ν. With no fitted parameters, this spectral density at frequencies up to 500 GHz was in excellent agreement with the prediction (2hν/R)coth(hν/2k/sub B/T). The presence of the zero-point term, 2hν/R, at frequencies hν>k/sub B/T was clearly demonstrated. The current-voltage characteristics of a junction with β/sub L/equivalent2πL/sub s/I_0/Phi$_0\sim$1 and β/sub C/equivalent2$\pi I_0 R^2$C/Phi$_0<<$1, where I_0 is the critical current, C is the junction capacitance, and L/sub s/ is the shunt inductance, showed structure at voltages where the Josephson frequency was near a subharmonic of the L/sub s/C resonant frequency. The additional nonlinearity of the I-V characteristic caused mixing down of noise near higher harmonics of the Josephson frequency, thereby greatly enhancing the voltage noise. The measured noise was in good agreement with that predicted by computer simulations.

61882 **Respirator canister evaluation for nine selected organic vapors.** Stampfer, J.F. (Los Alamos National Lab., NM). *American Industrial Hygiene Association Journal;* **43**: No. 6, 319-328(May 1982).

The protection afforded by one commercial organic vapor respirator canister (MSA/GMA) against chloroform, benzene, epichlorohydrin, acrylonitrile, propargyl alcohol, 1,2-dibromoethane, acrolein, chloromethyl methyl ether, and N-nitrosodimethylamine was determined. Six canisters were challenged simultaneously at 64 liters per minute (measured at 7000 ft elevation) with test atmospheres of these compounds at both 80% and <15% relative humidity (RH). The challenge concentrations were, in general, the greater of 50 times the threshold limit value or 1 ppm. Breakthrough volume was defined as that volume of air which passed through the canister before the downstream concentration was 1% of the challenge concentration. Tests were continued until as least this concentrations was attained or 16 h had elapsed, whichever occurred first. Under a moderate workload, these canisters should afford adequate protection against chloroform, benzene, and acrylonitrile for at least 4 h, epichlorohydrin for at least 8 h, and the remaining compounds (except chloromethyl methylether) for at least 16 h. Chloromethyl methyl ether at 80% RH exhibited a minimum penetration of 30% after only 34 min. It appears that this and similar canisters will not provide adequate protection against atmospheres containing this compound. In all tests in which breakthrough occurred, the decrease in breakthrough time with increase in relative humidity was greater than would be expected from published literature.On the basis of these results, suggestions are made for changes in the present National Institute for Occupational Safety and Health/Mine Safety and Health Administration certification procedures.

61883 **Impact of the January 1980 earthquakes on the Lawrence Livermore National laboratory.** Becker, R.C. (Lawrence Livermore National Lab., CA); Hill, E.E.; Zevanove, L.R.; Di Grazra, H.X. *Nuclear Safety;* **23**: No. 2, 198-213(Mar 1982).

The Lawrence Livermore National Laboratory (LLNL) a large research laboratory primarily devoted to nuclear weapons design, was struck by two moderately severe earthquakes in January 1980. Damage, though not minor, was not extensive considering the duration and magnitude of the earthquakes. Taking advantage of the experience, LLNL set up a committee to conduct extensive evaluations of its design criteria, for both critical and noncritical facilities, and of its emergency response procedures. The committee's report recommended 25 measures for upgrading earthquake preparedness based on LLNL's and other institutions' earthquake experience. This article is based on that report.

4203 Lasers

REFER ALSO TO CITATION(S) 62485

61884 **(AD-A—112439/5) The evaluation of saturated amines as potential ultraviolet laser sources. Final report 30 Sep 80-31 Dec 81.** Halpern, A.M. (Northeastern Univ., Boston, MA (USA). Dept. of Chemistry). 25 Feb 1982. 18p. NTIS, PC A02/MF A01.

The specific goal of the project as outlined in the proposal was to determine whether under various pump conditions saturated amines could be observed to lase in the expected ultraviolet (280 - 320 nm) region. A variety of chemical and physical systems was chosen in order to maximize the likelihood that lasing action could be produced and observed. While superradiant fluorescence was almost always detected under conditions of 249-nm KrF* laser irradiation, no evidence of amine lasing was obtained for any compound under any conditions (i.e. vapor or condensed phase). For vapor phase systems, it was observed that extensive ionization current was produced consequent to laser pumping. While quantitative measurements of the ion yields were not performed, it is believed that the principle loss mechanism in the amine laser cavity is via up-pumping to an ion state of the parent (or fragment). Thus, despite the initially favorable prognosis of these compounds with respect to lasing action, i.e., relatively easily achievable threshold conditions, the up-pumping cross section of these compounds is apparently too large to allow for net amplification.

61885 **(DOE/DP/40045—1) Efficient KrF-laser pulse compression. Final report.** Stappaerts, E.A. (Northrop Research and Technology Center, Palos Verdes Peninsula, CA (USA)). 30 Apr 1982. Contract AC08-78DP40045. 76p. NTIS, PC A05/MF A01. Order Number DE82021926.

This report describes the results of theoretical and experimental studies performed at Northrop Research and Technology Center (NRTC) as part of a DOE sponsored program on pulse

compression techniques for advanced ICF drivers. The first objective of this program was a detailed theoretical study of a novel pulse compression technique independently proposed by NRTC and Lawrence Livermore Laboratories. The basis of the new technique is the use of linearly expanding beams as opposed to collimated beams in backward Raman pulse compressors. The expectation was that this new geometry would considerably enhance the compressor performance, especially with respect to the buildup of second Stokes parasitics. Detailed analysis and extensive computer simulations carried out as part of this program have shown, however, that the advantages are not as pronounced as expected, especially with respect to parasitic suppression.

61886 **(DOE/DP/40141—1) Direct beam-quality measurement in pulsed aerodynamic windows. Final report, August 1981 to May 1982.** Kulkarny, V.A.; Shwartz, J.; Saffman, M. (TRW, Inc., Redondo Beach, CA (USA)). 12 Aug 1982. Contract AC08-81DP40141. 17p. NTIS, PC A02/MF A01. Order Number DE82019285.

Aerodynamic windows provide pressure and gas species isolation interfaces which are transparent to laser radiation. For short, high-energy laser pulses, the transient flowfield in a shock tube may be used as a single shot window. Here the laser pulse is transmitted along the tube axis a short time after the diaphragm ruptures. The feasibility of this Pulsed Aerodynamic Window concept was experimentally investigated in order to establish the optical transmission quality of the transient flowfield in the tube. In the previous phase of this effort the OPDF of the shock tube medium was characterized with interferometry. The present phase addressed a direct measurement of the beam quality (BQ) of a laser pulse transmitted through the shock tube flowfield, by recording the intensity pattern at a focus.

61887 **(INIS-mf—7048) Proceedings of the 4. International Conference on Lasers and their Applications.** (Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Optik und Spektroskopie; Physikalische Gesellschaft der DDR, Berlin (German Democratic Republic)). 1981. 268p. (In English and Russian). (CONF-8110182—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE82780692.

From 4. international conference on lasers and their applications; Leipzig, German Democratic Republic (19 Oct 1981).

400 scientists from 19 countries participated in the 4. international conference on lasers and their applications, held at Leipzig, GDR, in October 1981. The conference focused on problems of gas lasers, high-power lasers for materials working, and laser spectroscopy, on optoelectronics considering communications systems, and on laser-controlled thermonuclear fusion with special regard to the laser plant 'Delphin 1'. 186 summaries are included.

61888 **(MPQ—52) Evaluation of the iodine laser.** Hagen, W.F. (Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). Sep 1981. 109p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE82906233.

Portions of document are illegible.

The computer model developed at Lawrence Livermore National Laboratory for calculating Nd-glass laser systems has been modified and extended for application to the iodine laser. On the basis of the experimental results obtained with the Asterix III iodine laser this model has been tested for its validity and then been applied for optimising iodine laser system components. Furthermore a cost analysis has been done and the results are compared with those of Nd glass laser systems.

61889 **(N—82-15913) AlGaAs/GaAs transverse junction stripe lasers with distributed feedback.** Hafich, M.J.; Skogman, R.A.; Petersen, P.E.; Kawanishi, H. (Honeywell, Inc., Bloomington, MN (USA)). Dec 1981. 10p. NTIS, PC A15/MF A01.

In Optical Information Processing for Aerospace Applications, pp 241-250. See N—82-15894.

Transverse junction stripe (TJS) lasers with periodic feedback were fabricated in two geometries. An interferometric and wet chemical etching technique was used to create a feedback grating across the entire pumping region for the distributed feedback (DFB) TJS laser and to create the separate distributed Bragg reflectors/DBR) for the TJS/DBR laser. The TJS/DFB laser was a double heterostructure device grown by liquid phase epitaxy (LPE) and had a third order grating etched in the top ALO.2GaO.8As layer. The grating was buried by growing an ALO.35GaO.65As layer on the grating by metal organic chemical vapor deposition (MO-CVD). The TJS/DBR laser was also fabricated in an LPE double heterostructure. The top AlGaAs layer was thinned to 0.1 micron over more than half of the laser so that the grating would be close to the GaAs active layer and optical field. Single mode operation in both configurations was obtained. The thermal shift of the laser wavelength in both cases was less than 1 Angstrom/deg K, compared to the 3 Angstrom/deg K shift of the spontaneous emission peak.

61890 **High pressure measurements on Al/sub x/Ga/sub 1-x/As-GaAs (x = 0.5 and 1) superlattices and quantum well heterostructure lasers.** Kirchoefer, S.W.; Holonyak, N. Jr.; Hess, K.; Meehan, K.; Gulino, D.A.; Drickamer, H.G.; Coleman, J.J.; Dapkus, P.D. (Electrical Engineering Research Laboratory and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Journal of Applied Physics;* 53: No. 9, 6037-6042(Sep 1982). Contract AC02-76ER01198.

Absorption data on AlAs-GaAs and Al/sub x/Ga/sub 1-x/As-GaAs superlattices (SL's) and emission data on Al/sub x/Ga/sub 1-x/As-GaAs quantum well heterostructure (QWH) laser diodes subjected to hydrostatic pressure (0—10 kbar) at 300 K are presented. Superlattice absorption data show that the confined-particle transitions, which partition and "label" the Γ energy band high above the band edge, all move with the same pressure coefficient of 11.5 meV/kbar. (For bulk GaAs, the pressure coefficient is 12.5 meV/kbar.) The effect of the L indirect minima on the highest observed confined-particle transitions is small; the effect of the X minima is large. At lower pressures, QWH diodes exhibit a pressure dependence similar to that of the free (unconstrained) SL's. The data on QWH diodes demonstrate, however, a size-dependent [L/sub z/(GaAs)<500 A] shift in slope to a lower (8.5 meV/kbar) energy gap versus pressure coefficient at higher pressures. This change in slope can be explained by considering the effect on the light- and heavy-hole subbands of shear stresses generated within the p-n diode heterostructure.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 60755, 61192, 61253, 61254, 61256, 61257, 61258, 61259, 61435, 61439, 61440, 61500, 61544, 61574, 61575, 61879, 61904, 61957

61891 (INIS-SU—19, pp 8-13) **Pressure field of a vapor jet outflowing into cold water.** Balakleevskij, Yu.I.; Koronkevich, M.A. (AN SSSR, Novosibirsk. Inst. Teplofiziki:. 1980. (In Russian). Dep. NTIS (US Sales Only).

From 4. all union conference on heat-masstransfer; Minsk, Byelorussian, USSR (Sep 1980).

Thermal hydrodynamic processes taking place at a vapour jet condensation in the liguid volume are analytically and experimentally studied. The results of pressure drop calculations of a vapour jet inflowing into the liquid are presented. Experimental results of static pressure measurements in the whole field of flow of plane subsonic vapour jet outflowing harizontally into water from the flat narrowing nozzle are given. Experiments are performed under the nozzle saturating vapour pressure P_0=130-170 kPa, water temperature t_0=10-42 deg C, cut-off height and width of the nozzle equal 11.2 mm and 29.3 mm, respectively . Isobars for two modes (P_0=151 and 171 kPa, t_0=40 and 15 deg C) are presented. It is shown that the pressure drop from the zero value at the nozzle edge smoothly increases along the "condensation front" up to the maximum value. This can be explained only by the fact that the profile of rate in the nozzle cross section is analogous to the corresponding profile in the gas-liquid flow at disperse-ring flow mode, i.e. it is "laminarized". The pressure decrease in the vapour "cone" testifies to the fact that vapour outside the nozzle accelerates. This should be taken into account at the "condensation front" vapour parameters calculation.

61892 **(NP—2904063) Relationships between wall-pressure- and velocity-fluctuations in turbulent pipe flow (experimental investigation).** Langeheineken, T. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). 1981. 126p. (In German). NTIS (US Sales Only), PC A07/MF A01.

In a fully developed turbulent pipe flow (air flow, Reynolds-number based upon centerline-velocity and pipe diameter, Resub(D) = 9600) the fluctuating components of the wall pressure, p', of the streamwise velocity, u', and of the velocity perpendicular to the wall, v', were measured simultaneously. Using the method of conditional signal-averaging, the relationship between high amplitude pressure-fluctuations at the pipe wall and the velocity field in the flow was measured. The measurements showed, that a relationship exists - namely that the occurrence of high amplitude positive and negative peaks in the wall-pressure are closely connected to the velocity field, which in turn shows, among other features, long and narrow streaks with high and low velocity. This relationship was measured within a large area in the flow. The occurrence of high amplitude wall-pressure peaks in particular was found to be related to the behaviour of the velocity field, which is assumed to occur during a burst . A flow model consisting of vortex tubes similar to the well-known horseshoe- or hairpin-vortices could be established, which explains the main features of the results of the measurements.

61893 **(NP—2904064) Experimental investigation of a probe interference in the near wall region in a turbulent channel flow.** Klages, H. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). 1981. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01.

An investigation of space-time-correlations with hot-film-probes in the Goettingen Oil-Channel is reported. These measurements were made within the viscous sublayer and adjacent wall region; the Reynolds number is 7770, based on the channel width and the mean centreline velocity. At this Reynolds number, the thickness of the viscous sublayer ($y^+ = 5$) is approximately 3 millimeters. The measurements show changes of sign for correlations of the fluctuating velocity component w' and the corresponding gradient at the wall $(deltaw'/deltay)_0$. These inversions are dependent on the probe position within the flow field ($y^+ <= 5$) in relation to the gradient-probe position and are also dependent on the probe type. Measurements with a new gradient probe with high spatial resolution show the presence of streamwise vortices parallel to the wall. These streamwise vortices are found to precede sweeps and possess an axis of rotation near y^+ approx. equal to 25.

61894 **(SAND—82-1291C) Mixture theory for turbulent diffusion of heavy particles.** McTigue, D.F. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 24p. (CONF-8205115—1). NTIS, PC A03/MF A01. Order Number DE82019341.

From Advanced seminar on the theory of dispersed multiphase flow; Madison, WI, USA (26 May 1982).

A number of studies have recognized the need to include momentum considerations in order to properly represent certain two-phase flows. However, none of these studies identifies both buoyancy effects and the source of the diffusive flux in the manner presented here. This paper examines the classical sedimentation problem in view of the continuum theory of mixtures. The central object is to identify the source of the diffusive flux that balances the gravitational settling flux of negatively buoyant particles in a steady, uniform mean flow. Mixture theory offers a powerful tool for examination of this problem. It provides a rigorous axiomatic framework for the dynamics of two-phase flow, explicitly including exchanges of momentum between the phases. The theory very clearly demarcates the behavior of the fluid phase, the dispersed particulate phase, and the total mixture.

4205 Materials Testing

61895 (INIS-SU—29, pp vp) **Measurement of material sheet thickness in case of background radiation presence.** Krejndlin, I.I.; Novikov, V.S.; Pravikov, A.A. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Radiation technology.

The effect of background radiation on the results of measuring sheet material thickness by three methods using β-radiation: absorptiometric, back scattered radiation with and without substrate, is considered. Comparison of relative statistical errors during measuring thickness of sheet materials by each of the mentioned methods w+th and without background radiation for optimum measuring conditions, is carried out. Curves of relative statistical error are given.

61896 **(UCID—19417) Review of the nondestructive evaluation of weldments.** Boyd, D.M.; Shackelford, J.F. (Lawrence Livermore National Lab., CA (USA)). 10 Aug 1982. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01. Order Number DE82021947.

The nondestructive evaluation (NDE) of weldments has been reviewed from the perspective of LLNL needs. An emphasis is made on the verification of strain history and residual stress predictions of thermomechanical models. Two classes of measurement techniques are identified: on-line welding inspection (of strain history) and postprocessing inspection (of residual stress). In the first category, quantitative NDE has been demonstrated by strain gage and moire techniques. Other methods, such as acoustic emission and ultrasonics, are useful for process control rather than strain history characterization. For postprocessing characterization of residual stress, x-ray diffraction remains as the established, quantitative NDE. Recent progress has been made in speed and equipment portability for such inspections. The most promising alternative to x-ray diffraction is the use of the acoustoelastic effect. This results from rapid progress in ultrasonic measurement technology. However, substantial development work remains due to the sensitivity of ultrasonic velocity to specimen microstructure. The state-of-the-art NDE methods are adequate to treat many welding problems of importance to LLNL. The most productive areas for LLNL research effort in this field include high temperature strain measurement and residual stress measurement by x-ray diffraction and ultrasonics.

61897 **(UCRL—15487) Frequency effect on the fatigue life of [+45]/sub 2S/S2 glass-epoxy.** Sun, C.T.; Doyle, J.F.; Tsai, G.C. (Purdue Research Foundation, Lafayette, IN (USA)). Jul 1982. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01. Order Number DE82021384.

Fatigue tests were conducted on [+45]/sub 2S/ glass/epoxy composite laminates using 4, .4, and .04 Hz frequencies. Fatigue life was found to increase as the load frequency increased. The frequency-dependent behavior of the dynamic modulus was used to interpret the frequency-dependent fatigue life. Experimental results showed that the dynamic modulus of this composite is larger at higher frequencies. When the fatigue load was adjusted according to the frequency so that the same strain amplitude was applied at different frequencies, fatigue life became less dependent on the frequency.

61898 **(UCRL—87639) Relationship of NDE to fitness-for-purpose.** Maxfield, B.W. (Lawrence Livermore National Lab., CA (USA)). 1982. Contract W-7405-ENG-48. 34p. (CONF-8205106—1). NTIS, PC A03/MF A01. Order Number DE82016841.

From American Welding Society conference; Atlanta, GA, USA (18 May 1982).

Portions of document are illegible.

Qualitative nondestructive evaluation (QNDE) is required for evaluating materials, welded joints, machine parts and structures for fitness for purpose (FfP); that is FpP requires materials testing methods which are able to detect small defects and which can determine the location, orientation, size and shape of a defect so that the influence of the local stress level on the defect growth rate under either static or dynamic loading conditions can be evaluated. The following NDE methods and their applicability to FfP are compared: liquid penetrant inspection; magnetic testing; optical interferometric methods; eddy current testing, radiographic methods and ultrasonic testing. It is concluded that ultrasonic methods are currently the most advanced and promising providing QNDE or fracture mechanics information, and that within two to four years simple, practical economical field NDE procedures will be available which will provide the information needed to apply FfP criteria for judging the acceptability of welds. (LCL)

4206 Safety Engineering

REFER ALSO TO CITATION(S) 61560

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 61954, 62372

61899 (BDX—613-2805) Advanced programmer manufacturing. Final report. Emmons, J.M.; Caruthers, D.J. (Bendix Corp., Kansas City, MO (USA)). Aug 1982. Contract AC04-76DP00613. 67p. NTIS, PC A04/MF A01. Order Number DE82021308.

Point-to-point wiring in electronic packages was reduced by redesigning the package and using multilayer printed wiring boards (PWBs). Processes to provide a leak rate of less than 1 x 10^{-6} cm^3/s were determined, but a low moisture content of 20 parts per million over the assembly life could not be achieved. Several materials were considered for use as a conformal coating, from which a two-component urethane which could be applied in multiple thin coats was chosen. A three-cycle (dip, spin, and oven-cure) process was developed for application of the material. Raised lands were evaluated, and recommendations to reduce their occurrence are given.

61900 (BDX—613-2821) Evaluation of semiconductor chips for Bendix-built hybrid microcircuits. Final report. Harger, T.A. (Bendix Corp., Kansas City, MO (USA)). Sep 1982. Contract AC04-76DP00613. 8p. NTIS, PC A02/MF A01. Order Number DE82021307.

A process was established by which a representative cross section of the military-grade integrated circuit (IC) chips, procured from commercial suppliers for use in the production of telemetry hybrid microcircuits (HMCs), could be qualitatively assessed. This was accomplished by first packaging 10 representative groups of ICs using processes and tooling adapted from existing production applications. The groups were then preconditioned and electrically tested using existing product specifications, hardware, and software. These tasks were performed to determine the reliability of the published electrical characteristics of the devices at temperature extremes and through preconditioning. No formal acceptance testing is performed on the semiconductor chips procured for the telemetry HMCs at the component level.

61901 (LA-UR—82-2400) Breakdown criteria due to radio-frequency fields in vacuum. Final report. Reid, D.W.; Lohsen, R.A. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 7p. (CONF-821024—3). NTIS, PC A02/MF A01. Order Number DE82021883.

From 10. international symposium on discharges and electrical insulation in vacuum; Columbia, SC, USA (25 Oct 1982).

The factors that affect the voltage at which vacuum gaps break down are analyzed. Based on the literature and some simplifying assumptions, a functional dependence is hypothesized. The hypothesis is related to a proposed experiment using radio-frequency power to generate the breakdown voltage.

61902 Field ion microscopy and pulsed laser atom-probe mass spectroscopy of insulating glasses. Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **53**: No. 9, 6383-6386(Sep 1982). Contract AC04-76DP00789.

Field ion microscopy and atom-probe mass spectroscopy of insulating glasses are reported for the first time. Procedures for preparing, field ion imaging, and atom-probe mass analyzing samples of pyrex (Corning 7740 glass) and fused quartz are presented.

61903 High-precision triangular-waveform generator. Mueller, T.R. (to Dept. of Energy). US Patent Application 322,145. 14 Nov 1981. 15p. Contract W-7405-ENG-26.

An ultra-linear ramp generator having separately programmable ascending and decending ramp rates and voltages is provided. Two constant current sources provide the ramp through an integrator. Switching of the current at current source inputs rather than at the integrator input eliminates switching transients and contributes to the waveform precision. The triangular waveforms produced by the waveform generator are characterized by accurate reproduction and low drift over periods of several hours. The ascending and descending slopes are independently selectable.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 60746

61904 (DOE/PC/30214—T4) Heat transfer to tubes in freeboard space of fluidized-bed combustors. Progress report, February 1, 1982-August 1, 1982. Chen, J.C.; Tuzla, K.; Biyikli, S. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Mechanical Engineering and Mechanics). Aug 1982. Contract FG22-80PC30214. 12p. NTIS, PC A02/MF A01. Order Number DE82020247.

Portions of document are illegible.

Progress is reported in experimental studies of the heat transfer characteristics of tubes located in the freeboard region of fluidized beds. The objectives of this research are to: obtain experimental data for heat transfer in freeboard region for single tubes at room temperature and at FBC operating temperatures; determine the effect of operating variables (gas velocity, tube elevation, particle size, particle density, etc.) on heat transfer coefficients; develop on experimental method for determinating the dominant heat transfer mechanisms in freeboard region, from solid contact measurements, in room temperature bed; and derive phenomenological models and correlations. The test equipment has been assembled and initial results for heat transfer coefficients at temperatures from 25°C to 750°C and flow rates of 1.5 and 3.0 m/s are presented. (LCL)

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 60835, 62015

61905 (PB—82-196924) Mechanisms of dry SO_2 control processes. Final report Sep 80-Sep 81. Apple, C.; Kelly, M.E. (Radian Corp., Durham, NC (USA)). Apr 1982. 137p. NTIS, PC A07/MF A01.

The report discusses physical and chemical processes and reaction mechanisms for lime spray drying and dry injection of sodium compounds in dry flue gas desulfurization (FGD) processes. It includes: chemical reactions, physical changes, proposed reaction mechanisms and mathematical models, process parameters affecting reactions and their rates, and data needed to verify proposed reaction mechanisms and models. Published technical papers were the primary reference sources. The report focuses on coal-fired boiler dry FGD applications. Lime spray drying reactions are primarily gas/liquid-phase reactions, with SO_2 removal depending on moisture in the lime slurry droplet. Initially, the moisture content is high, and the reaction rate is controlled by diffusion of SO_2 to the droplet surface; most SO_2 removal occurs during this phase. As evaporation reduces the moisture, the dissolution of $Ca(OH)_2$ into ions limits the SO_2 removal rate. Later, the precipitation of $CaSO_3.1/2\ H_2O$ onto the surface of the lime particles retards diffusion of SO_2 to the unreacted sorbent. Injecting sodium compound powders into flue gas removes SO_2 via gas/solid reactions. First, $NaHCO_3$ is thermally decomposed to Na_2CO_3 (small pores in the sorbent particles increase the particles' surface area and reactivity). Then the SO_2 reacts with Na_2CO_3 to form Na_2SO_3, starting at the particle surface.

61906 (PB—82-202573) Fossil fuel fired industrial boilers - background information. Volume 1: Chapters 1-9. Draft report. (Environmental Protection Agency, Atlanta, GA (USA). Region IV). Mar 1982. 553p. NTIS, PC A24/MF A01.

This document provides background information for the fossil fuel-fired industrial boiler source category. Fossil fuels considered include coal, oil and natural gas. Background information for industrial boilers includes a survey of boiler types, sizes, operating characteristics, and existing State and Federal regulations. Uncontrolled emissions of particulate matter, sulfur dioxide and nitrogen

oxides are quantified and factors affecting these emissions are discussed. Control technologies for particulate matter, sulfur dioxide and nitrogen oxides are identified and discussed with respect to the technologies' applicability to industrial boilers, developmental status, and factors affecting performance. Emissions data for each technology are also presented. Finally, environmental, energy and cost impacts of applying these technologies to fossil fuel-fired industrial boilers are presented and discussed. This information was developed in support of potential new source performance standards for industrial boilers.

61907 **(PB—82-203209) Nonfossil fuel fired industrial boilers: background information.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Mar 1982. 791p. NTIS, PC A99/MF A01.

This document provides background information about air emissions and controlling these emissions for the nonfossil fuel fired boiler (NFFB) source category. This source category includes boilers firing wood, bagasse (sugar cane residue), municipal type solid waste, and refuse derived fuels. This document identifies the industries which use NFFBs and the numbers of new NFFBs expected to be built in 1982 through 1990. The uncontrolled emissions of particulate matter, sulfur dioxide, and nitrogen oxides are quantified and factors affecting these emissions are discussed. State and Federal regulations which apply to the NFFB source category are summarized. Control technologies to reduce these emissions are identified and emission test data are presented. Factors which affect the performance of emission control technologies are also discussed. Finally, environmental, energy and cost impacts of applying these control technologies to nonfossil fuel fired boilers are presented and discussed. This information was developed in support of a potential new source performance standard for nonfossil fuel fired boilers.

61908 **(RFP-Trans—328) Technique for removing heavy-metal ions from wastewater and examples of its application.** Shimizu, S. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Aug 1982. Contract AC04-76DP03533. Translated from PPM-1977/9, pp 52-63. 26p. NTIS, PC A03/MF A01. Order Number DE82021720.

Portions of document are illegible.

The ferrite precipitation method of heavy metal containing wastewaters is discussed. The technique consists of the treatment of heavy-metal ions in wastewaters by adding ferrous ions in order to remove the heavy metal ions in the form of a ferrite, a highly magnetic oxide precipitate. (ACR)

61909 **Theoretical collection efficiencies of adsorbent samplers.** Senum, G.I. (Brookhaven National Lab., Upton, NY). *Environmental Science and Technology;* **15**: 1073-1075(Sep 1981).

The use of adsorbents in adsorption tube samplers for the collection and preconcentration of volatile components in air samples requires a knowledge of a maximum safe sampling volume or breakthrough volume in order to guarantee a quantitative collection. Previously there have been several arbitrary definitions of a breakthrough volume which have had various dependencies on the component retention volume and, in some instances, on the number of theoretical plates of the adsorbent. As a result of the application samplers, a breakthrough volume is defined and explicitly expressed in terms of a required collection efficiency, the retention volume for the adsorbate/adsorbent combination, and the number of theoretical plates of the adsorbent.The specified collection efficiency is guaranteed for an adsorption tube sampler as long as the sampled volume is less than this breakthrough volume.

61910 **Field measurements of the benefits of increased stack height.** Nickola, P.W. (Battelle Pacific Northwest Laboratories, Richland, Wash.). pp 89-94 of Symposium on turbulence, diffusion, and air pollution, 4th, Reno, NV, January 15-18, 1979, preprints. Boston, MA; American Meteorological Society (1978). Contract AC06-76RL01830.

From 4. symposium on turbulence, diffusion and air pollution; Reno, NV, USA (15 Jan 1979).

The degree to which ground-level concentrations of atmospheric pollutants can be reduced by increasing stack height was investigated in a series of experiments entailing simultaneous release of two tracers (zinc sulfide and fluorescein) at different heights and sampling of tracer concentrations on arcs at radial distances of 200, 800, 1600 and 3200 m from the source. The ratios of normalized crosswind-integrated concentrations resulting from simultaneous release of the two tracers were obtained for a variety of stability conditions. It was found that at distances relatively far from the source, benefits in reduced concentration associated with increasing source height from 26 m to 56 m plateau at about the ratio of wind speeds at the 26 m and 56 m levels. The benefits resulting from an increase in source height from 56 to 111 m exceed the ratio of wind speeds at these levels at all distances.

4250 Power Cycles

REFER ALSO TO CITATION(S) 61247

43 PARTICLE ACCELERATORS

61911 **(KFK—3228) Proceedings of the workshop on high intensity accelerators and compressor rings.** Kuntze, M. (ed.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Nov 1981. 259p. (CONF-8106243—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE82780742.

From Workshop on high intensity accelerators and compressor rings; Karlsruhe, F.R. Germany (25 Jun 1981).

The papers presented were entered in the data base separately. (WHK)

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 62494

61912 (INIS-SU—31, pp 11-24) **Comparative performances of low-energy electron accelerators.** Aleshin, E.R.; Shchedrin, I.S. 1980. (In Russian). Dep. NTIS (US Sales Only).

In Accelerators. No. 19. Theory calculation experimental works on charged particles accelerators.

Performances of betatrons, microtrons and electron linacs (ELA) are considered on an example of installations used in medicine, flow detection and other applied spheres. Electron linacs are compared according to the beam output parameters taking into account gamma radiation energies and its intensities, as well as the mass and volume of the main part of the electron linacs - a radiator block. Separate accelerator system are considered. The limiting parameters of operating electron accelerator are presented. The conclusions are made that the ELA is the most perspective type of industrial accelerators.

61913 (INIS-SU—31, pp 25-29) **Electron source with a small beam emittance.** Ginzburg, V.E.; Gugnin, A.A.; Luchin, A.A.; Petrenko, V.V.; Ponomarev, V.N.; Chervinchuk, S.Yu. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij:. 1980. (In Russian). Dep. NTIS (US Sales Only).

In Accelerators. No. 19. Theory calculation experimental works on charged particles accelerators.

Results of experimental investigation of a three-electrode electron gun with the 80 keV electron beam energy and small emittance are presented. The cathode gun unit consists of a heater in the form of a wire of the VP-20 alloy of the 0.35 mm diameter, two sectoral screens of molybdenum and a fixture element of copper on which a heater with an iridium-cerium cathode of the 2.5 mm diameter, screens and lead electrodes are mounted. The calculation results for the electronic-optical systems of the electron gun are presented. As a result of gun investigations the following results are obtained: beam divergence is about 5×10^{-4} rad at the output from the second anode; the peak beam current is up to 4.7 A.

61914 (INIS-SU—31, pp 80-85) **Calculation of a cathode unit with ring emitters.** Gavrilov, N.M.; Nesterovich, A.V. 1980. (In Russian). Dep. NTIS (US Sales Only).

In Accelerators. No. 19. Theory calculation experimental works on charged particles accelerators.

To increase the electron current in an electron gun with a hole on the axis the calculation of a cathode unit is carried out. The cathode unit consists of 10 cathodes in the form of a tungsten ring of a rectangular cross section of the 1 mm thickness, internal and external diameters of 16 and 20 mm, respectively. It is shown that at the 2400 K tungsten cathode temperature, j=0.2 A/cm^2 emission current density and $\omega/j=288$ V parameter, where ω is power emitted by the cathode, the emission cathode current is 0.24 A and voltage between the adjacent cathodes is 860 V. The schematic diagram of the cathode unit supply system are given. The system ensures s nchronization of the high-voltage extending pulse with the voltage peaks on the cathodes. The calculation results have shown that the given method of current increasing in electron guns with the limited transverse dimensions can be realized without any difficulties.

61915 (INIS-SU—31, pp 90-94) **Study on the beam radial motion in a linear accelerator of a high-energy scanning electron microscope.** Polyakov, V.A.; Shchedrin, I.S. 1980. (In Russian). Dep. NTIS (US Sales Only).

In Accelerators. No. 19. Theory calculation experimental works on charged particles accelerators.

The possibility of construction of a scanning electron microscope on the basis of a resonance electron linac of the 3 cm range at the 5 MeV energy is considered. The radial beam motion assuming the absence of parameter instabilities and inaccuracy in fixing of the power supply system focusing system and injection system are studied. Calculation of motion of an electron group with phase extent of 1-1.5 deg has shown a great beam current nargin. At the number of electrons in bunch up to 10^3 the dependence of the bunch phase width along the acceleration length changes inconsiderably. While injecting beams with the radius of 10 to 100 nm and zero initial divergence a sharp beam radius increase up to the value of the 10^4 nm order is observed.

61916 (INIS-SU—31, pp 97-104) **Measuring the quality factor of resonators with N coupling lines.** Androsov, V.V. 1980. (In Russian). Dep. NTIS (US Sales Only).

In Accelerators. No. 19. Theory calculation experimental works on charged particles accelerators.

A measuring technique for the proper quality factors coupling coefficients and power transfer coefficients for superconducting resonators with N coupling lines is proposed. The equivalent resonator diagram is given. Two methods of determination of the resonator proper quality factor according to the maximum transfer coefficients at reconstructed couplings and at measured coefficients of reflection from the resonator are considered. The conditions of the minimum measurement error for measurements on the maximum transfer coefficient in case of reconstructed couplings, as well as the conditions of the minumum error during calculation by the transfer method are given. However the techniques and methods considered are applicable for investigation of superconducting resonators, but they can be successfully used at room temperature as well, besides they permit to essentially reduce the measurement time.

61917 (LBL—13150) **Variation of the Moyer Model Parameter, H_0, with primary proton energy.** Liu, K.L.; Stevenson, G.R.; Thomas, R.H.; Thomas, S.V. (Lawrence Berkeley Lab., CA (USA)). Aug 1982. Contract AC03-76SF00098. 34p. NTIS, PC A03/MF A01. Order Number DE82020574.

Experimental values of the Moyer Model Parameter H_0 were summarized and presented as a function of proton energy, E/ sub p/. The variation of H_0(E/sup p/) with E/sup p/ was studied by regression analysis. Regression Analysis of the data under log-log transformation gave a best value for the exponent m of 0.77 +- 0.26, but a t-test did not reject m = 1 (p +- 20%). Since m = 1 was not excluded, and a Fisher's F-test did not exclude linearity, a linear regression analysis was performed. A line passing through the origin was not rejected (Student's t-test, p = 30%) and has the equation: H_0(E/sup p/ = (1.61 +- 0.19) x 10^{-13} Sv.m^2/GeV to be compared with a value of (1.65 +- 0.21) x 10^{-13} Sv.m^2/GeV published by Stevenson et al. (St 82).

4302 Beam Dynamics, Field Calculations, And Ion Optics

61918 **(JINR-R—9-81-711) Beam dynamics analysis for the JINR phasotron shaped magnetic field.** Vorozhtsov, S.B.; Dmitrievskii, V.P.; Zaplatin, N.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1981. 4p. (In Russian). (CONF-811254—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702660.

From All-union conference on low and middle ions accelerators; Kiev, Ukrainian SSR (1 Dec 1981).

Computer calculations of dynamic characteristic of the JINR phasotron magnetic field are presented aiming at producing stable acceleration with preservation of finite energy and beam radius. Beam dynamics analysis was performed by computer simulation of the injection, acceleration and extraction of the beam. Field correction was performed by shimming elements. The obtained results indicate that the shaped magnetic field after some correction provides for particle stable acceleration in the dynamic mode. The requied intensity and quality of the beam can be obtained at 50 kV RF-voltage and 100 mA beam current from the source.

61919 **Sagittal focusing of synchrotron X-radiation with curved crystals.** Sparks, C.J. Jr.; Ice, G.E. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.); Wong, J. (General Electric Co., Schenectady, NY (USA). Research and Development Center); Batterman, B.W. (Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 73-78(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

We describe the sagitttal focusing of X-rays with singly bent crystals that accept the meridian plane divergence from a similar but flat crystal to form a pair in a nondispersive two-crystal Bragg monochromator. Curved crystals can intercept from 5 to 20 times the sagittal divergence of curved mirrors at X-ray energies above 10 keV. Anticlastic (transverse) bending of the crystal is made negligible in the meridian plane with reinforcing ribs cut parallel to the plane of scattering. Results show that at energies of 10, 20, and 30 keV the bent crystal performs efficiently and images the source size at the Cornell High Energy Synchrotron Source.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 62092, 62237

61920 **(AECL—7330) Beam testing of the lab model 270° head magnet.** Hutcheon, R.M.; Gillies, B.A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1981. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702472.

A modern cancer therapy electron accelerator unit must satisfy many design constraints, one of which is the isocentric height above floor level. Usually 130 cm is considered the maximum height at which a nurse can work with a patient. The advent of higher energy machines has increasingly made this more difficult to achieve, as higher magnetic fields are required in the magnet that directs the beam onto the patient. A new 270° doubly achromatic magnet configuration has been developed which minimizes the isocentre height for a given maximum energy and maximum magnetic field. The system is an asymmetric two magnet configuration, with zero field index, equal fields and a bend of greater than 180° in the first magnet. It is compact, easy to manufacture and relatively insensitive to assembly tolerances. Energy defining slits are easily incorporated in the design and can readily be radiation shielded. Input and output beam matching and steering is easily accomplished with a compact input quadrupole doublet and small steering windings. The design and bench testing of such a head magnet for a 25 MeV electron accelerator is described in report AECL-7057. The present report details the testing of the magnet at both 10 and 21 MeV using the variable energy electron beam from the Therac 25 cancer therapy accelerator.

61921 **(AECL—7403) Field mapping and ray tracing the lab model AIR magnet.** Hutcheon, R.M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jun 1981. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702473.

An achromatic isochronous reflector (AIR) magnet designed and built for a 16 MeV medical electron accelerator was later modified for use in the higher energy Therac 25 accelerator system. Complete field maps and ray trace results for the modified magnet are presented, and a recommendation is made for changes which should improve the achromaticity.

61922 **(FERMILAB/TM—1126) Structural analysis of the central tracking chamber.** Leininger, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). 23 Jul 1982. Contract AC02-76CH03000. 42p. NTIS (US Sales Only). Order Number DE82021919.

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ANSYS has been used to determine the deflection of the central tracking chamber and stress levels during construction and in the final configuration.

61923 **(N—82-17043) Determination of the current density in electron beams.** Beil, R.J. (Vanderbilt Univ., Nashville, TN (USA)). Jan 1982. 31p. (NASA-CR—161855). NTIS, PC A25/MF A01.

Current gathering rotating probe techniques were used to examine the envelope shape and power density profile of electron beams used in electron beam welding devices. The electron power density contours which determine the shape of the weld vapor cavity, penetration, and local heat distribution were considered. A mathematical analysis consistent with a rotating probe technique necessary to determine the current density distribution (assumed symmetrically radial) in a cross-section of the beam is provided. An explanation of the experimental technique for obtaining data, a BASIC language computer program to determine the current density from the data, and a study indicating the level of confidence to be associated with results obtained are also provided. An example of the application of the analysis to some experimental electron beam data is included.

61924 **(NP—2903195) TRIUMF: scientific activities annual report, 1979.** (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Dec 1980. 145p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE82903195.

Portions of document are illegible.

Research at the TRIUMF cyclotron facility during 1979 is describd. Areas covered include: beam research and development; particle physics; nuclear physics and chemistry; research in chemistry and solid-state physics; applied research; theoretical physics; cyclotron systems; experimental facilities; and a summary of conferences, workshops and meetings. (GHT)

61925 **Progress and prospects at the National Synchrotron Light Source (NSLS).** Howells, M.R. (Brookhaven National Lab., Upton, NY (USA). National Synchrotron Light Source). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 17-27(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

This report discusses the NSLS project from inception until the present. The commencement and motivation for the program are considered from the viewpoint of the needs of various experiments and the concepts and the 'basic source' is introduced. The basic source has high brightness and tunability within the ranges 0-0.3 keV and 3-20 keV. The inclusion of tunability implies the use of monochromators and the role of these is discussed. The basic source is important because it satisfies a very large proportion of users. The strategy of NSLS in providing a good basic source and special devices (monochromators and wigglers) to allow coverage of the energy ranges outside those of the basic source is described. The response of NSLS to various other general and special needs of experimental users is described. Turning to the free electron laser project, a brief description of that device is given followed by a progress report of the overall NSLS construction program. The broad conclusion is that the NSLS facility will be completed within 2-3 months of its scheduled timescale and within its budget. This is considered to be a highly successful conclusion to the contruction program.

61926 **Stability of some soft X-ray monochromator crystals in synchrotron radiation.** Wong, J. (General Electric Co., Schenectady, NY (USA). Research and Development Center); Roth, W.L. (State Univ. of New York, Albany (USA). Dept. of Physics); Batterman, B.W.; Berman, L.E. (Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics); Pease, D.M. (Connecticut Univ., Storrs (USA). Dept. of Physics); Heald, S. (Brookhaven National Lab., Upton, NY (USA). Dept. of Metallurgy); Barbee, T. (Stanford Univ., CA (USA). Dept. of Materials Science). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 133-139(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

The stability in synchrotron radiation of β-alumina and beryl has been investigated by exposing the crystals in a white beam at CHESS operating at 5.2 GeV electron energy over a period of approx. equal to 100 h at an average radiant power of 28 W/cm^2. Rocking curves at the CuKsub(α) energy were used to monitor the diffraction properties before and after exposure to synchrotron radiation. A Si(220) crystal was used as the first crystal. It was found that both materials exhibit no catastrophic material failure. β-alumina is clearly proven stable with no degradation of its rocking characteristics. There was in fact indication of reflectivity improvement after exposure. Results on beryl are not conclusive because the starting material (a mineral specimen) had a lot of inherent microstructural and crystallographic defects. Rocking curves in the soft X-ray region at 10.5 A were also determined using a (10anti 10) RAP crystal as first crystal. A 19-layer 50 A d-spacing Nb-C sputtered film was also characterized for comparison.

61927 **National Synchrotron Light Source VUV and soft X-ray beam lines: Performance characteristics.** Klaffky, R.W.; Howells, M.R.; Williams, G.P.; Takacs, P.Z.; Godel, J.B. (Brookhaven National Lab., Upton, NY (USA). National Synchrotron Light Source). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 155-162(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

A total of five beam lines are currently being constructed and commissioned at the NSLS. The involve a 2.75° toroidal grating monochromator, a plane grating grazing monochromator, a large aperture modified Wadsworth monochromator, a Seya-Namioka instrument and a Czerny-Turner instrument. We present details of these beam lines and their anticipated operational characteristics.

61928 **Theory of a modified Wadsworth monochromator matched to a low energy storage ring source.** Howells, M.R. (Brookhaven National Lab., Upton, NY (USA). National Synchrotron Light Source). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 215-222(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

The concave diffraction grating in the Wadsworth mounting has been popular with synchrotron radiation spectroscopists because of its use of parallel light. This is well matched to experimental stations which are a great distance away from the source as would be the case in using a high energy synchrotron. For low energy storage rings the working distance is quite small and in this case it is appropriate to use a collimating mirror. Large collection angles are possible with this arrangement and reasonable resolution can be obtained using spherical surfaces. Astigmatism is much lower than for Rowland circle mountings. These questions are analyzed using an optical path function development and calculations are presented which include the aberrations both in the two optics and those caused by the large extension of the source in the direction of the radiation emission.

61929 **Optical design of grazing incidence toroidal grating monochromator.** Pouey, M. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Plasmas); Howells, M.R.; Takacs, P.Z. (Brookhaven National Lab., Upton, NY (USA). National Synchrotron Light Source). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 223-232(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

Design rules using geometrical optics and physical optics associated with the phase balancing method are discussed for stigmatic toroidal grazing incidence monochromators. To determine the optical performance of devices involving mirrors and/or gratings, ray tracing programs using exact geometry are quite widely used. It is then desirable to have some way to infer the practical performance of an instrument from a spot diagram created by tracing a limited number of rays. We propose a first approach to this problem involving an estimation of the geometrical intensity distribution in the image plane and the corresponding line spread function.

61930 **Use of diamond turned mirrors for synchrotron radiation.** Howells, M.R.; Takacs, P.Z. (Brookhaven National Lab., Upton, NY (USA). National Synchrotron Light Source). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 251-257(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

The diamond turning technique has great interest for users of synchrotron radiation because of its ability to produce surfaces of arbitrary shape. It also has the advantage of being well adapted to producing metal optics. These are of interest because they lend themselves to water cooling and hence represent one approach to the proplem of high synchrotron radiation power loadings on optical surfaces. The optical figure produced by diamond turning is generally adequate for synchrotron radiation applications. The main difficulty centers around the question of smoothness. Diamond turned surfaces must receive a final polish after machining before they are sufficiently smooth for use with ultra-violet or X-ray radiation. The manufacturing stages can be carried out by various groups in the optics industry and the National Synchrotron Light Source has procured a considerable number of mirrors and is having them polished for use on the VUV storage ring. At the time of writing one mirror has been completed and evaluated and we give the results for this and discuss the indications for the future. The important measurement of the r.m.s. height of the surface roughness has given a value of (3.4+-0.9) A using total integrated scattter of visible light at normal incidence.

61931 **Evaluation of CVD silicon carbide for synchrotron radiation mirrors.** Takacs, P.Z. (Brookhaven National Lab., Upton, NY (USA). Instrumentation Div.). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 259-266(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

Chemical vapor deposited silicon carbide (CVD SiC) is a recent addition to the list of materials suitable for use in the harsh environment of synchrotron radiation (SR) beam lines. SR mirrors for use at normal incidence must be ultrahigh vacuum compatible, must withstand intense X-ray irradiation without surface damage, must be capable of being polished to an extremely smooth surface finish, and must maintain surface figure under termal loading. CVD SiC exceeds the performance of conventional optical materials in all these areas. It is, however, a relatively new optical material. Few manufactures have experience in producing optical quality material, and few opticians have experience in figuring and polishing the material. The CVD material occurs in a variety of forms, sensitively dependent upon reaction chamber production conditions. We are evaluating samples of CVD SiC obtained commercially from various manufacturers, representing a range of deposition conditions, to determine which types of CVD material are most suitable for superpolishing. At the time of this writing, samples are being polished by several commercial vendors and surface finish characteristics are being evaluated by various analytical methods.

61932 **National Synchrotron Light Source in the infrared region.** Williams, G.P. (Brookhaven National Lab., Upton, NY (USA). National Synchrotron Light Source). *Nuclear Instruments and Methods in Physics Research;* **195**: No. 1/2, 383-387(1 Apr 1982).

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 - 17 Jul 1981).

We present a discussion of the utilization of the NSLS in the 1-100 μm infrared spectral region. A comparison is made of the respective brightnesses of the NSLS and of black body sources. The way in which each source may be utilized with a monochromator is discussed and comparative exit slit brightnesses are calculated for selected cases.

4304 Storage Rings

61933 **(BNL—31822) dc glow-discharge cleaning for accelerator.** Chou, T.S.; Hseuh, H.C. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 4p. (CONF-821024—4). NTIS, PC A02/MF A01. Order Number DE82022049.

From 10. international symposium on discharges and electrical insulation in vacuum; Columbia, SC, USA (25 Oct 1982).

Average pressure of 1 x 10^{-11} torr and vacuum stability are necessary for the successful operation of the proton storage rings such as ISABELLE. Vacuum degassing at high temperature and in situ bake-out will reduce the thermoout-gassing rate of the beam tubes to ~ 10^{-13} Tl/cm^2 sec, therefore achieving the required static pressure. The vacuum instability caused by beam-induced ion desorption can be solved by dc glow discharge cleaning. With evidence from this study, the present understanding of glow discharge in a cylindrically symmetric geometry is reviewed. Argon and argon/oxygen mixture serve as plasmas in the glow. The role of oxygen in cleaning the beam tubes during the glow discharge is demonstrated experimentally. Glow discharge cleaning with and without bake-out is also studied.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 61029, 61328, 61922, 62131, 62559

61934 **(DL/NUC/TM—55E) Development of a discrete component delay line for use on a multi-parameter focal plane detector.** Cunningham, R.A.; Przybylski, M.M. (Science Research Council, Daresbury (UK). Daresbury Lab.). Jul 1981. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702474.

The construction and performance are described of a hundred section delay line for use on a multi-parameter focal plane detector now under construction for the NSF QMG/2 type magnetic spectrometer. The line is made from commercially available inductors and capacitors which may be coupled directly to the detectors. The performance of this line is compared with that of distributed parameter lines of similar effective length.

61935 **(DL/NUC/TM—59E) Investigation of the performance of various germanium detectors in a Compton suppression shield.** Todd, D.M.; Nolan, P.J. (Science and Engineering Research Council, Daresbury (UK). Daresbury Lab.). Jan 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702484.

The performance of four germanium detectors with different geometries inside an escape suppression shield have been investigated. The measurements show that the use of escape suppression shields give an improved detection system. The best results were obtained for the biggest germanium detector used and there is also evidence that detectors with less inactive germanium layers give better results.

61936 **(INFN/TC—81/9) Use of step-wise motors for film feed.** Liguori, G. (Istituto Nazionale di Fisica Nucleare, Pavia (Italy)). 4 Jun 1981. 12p. (In Italian). Dep. NTIS (US Sales Only), MF A01. Order Number DE82903259.

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A description is given of step-wise motors adapted for photographic film detection systems, including diagrams of the control keyboard, command motor mechanism, and electric circuitry. The detection systems have been designed for the Pavia section of the Italian National Institute of Nuclear Physics. 12 figures, 2 tables.

61937 **(NP—2903943) Study of the properties of cellulose triacetate films as a solid-state detector of neutrons.** Pretzsch, G.; Doerschel, B. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 27 May 1980. 12p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82903943.

A description is given of experiments undertaken to determine the energy emission level of neutron-induced secondary particles in detector materials, and in particular the testing of cellulose triacetate film at a thickness of 130 microns, to be used in a neutron-havar dosimeter. 7 references, 3 figures.

61938 **(NP—2903944) Device for evaluating solid-state track detectors based on light-transmission measurements.** Streubel, G.; Melde, C.; Gruellich, A. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 14 May 1980. 13p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82903944.

Portions of document are illegible.

A description is given of a measuring device with long-term stability and relatively high accuracy. Systematic tests of the device indicate that the measuring range covers three orders of magnitude in evaluating neutron-irradiated organic solid-state track detectors, and that the range can be modulated by altering the corrosion conditions. The device is also found suitable for evaluating detectors subjected to irradiation by heavily charged particles. 9 references, 5 figures.

61939 **(NP—2903993) Sensitivity of thermoluminescent detectors to neutron radiation.** Pretzsch, G. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 20 May 1980. 12p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82903993.

Portions of document are illegible.

A theoretical determination is made of the neutron sensitivity of a LiF dosemeter. A schematic representation is given for designing a LiF albedo dosemeter and graphic data are given on computed sensitivity of an albedo dosimeter in relation to the energy of primary incident neutrons. 9 references, 2 figures, 1 table.

61940 **(NP—2904533) Calibration of a special neutron dosimeter based on organic solid state detectors.** Gruellich, A.; Doerschel, B.; Streubel, G.; Schuricht, V. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 15 May 1980. 17p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82904533.

Portions of document are illegible.

A description is given of experiments undertaken to determine the calibration factors for various neutron fields in evaluating dosimeters through the use of light-transmission measurements. Also determined is detector sensitivity to thermal albedo neutrons. A determination of the biological dose with the examined neutron-havar dosimeter was found to be possible in the neutron range of 10^{-8} to 20 MeV. The calibration factor of the dosimeter was found to be dependent upon the neutron spectrum wherein that factor sharply increases in weak spectra, and the sensitivity to thermal and intermediate neutrons by far surpasses sensitivity to fast neutrons. 10 references, 8 figures, 1 table.

61941 **(SAAS—287) Catalogue of response spectra for unfolding in situ gamma-ray pulse-height distributions.** Dymke, N. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1982. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82702485.

To unfold in situ gamma-ray pulse-height distributions by means of a response matrix technique, the matrix must be in keeping with the measurement geometry, detector size, and energy range to be covered by the measurements. A methodology has been described for determination of standard gamma-ray spectra needed in deriving response matrices and a spectrum catalogue compiled containing graphs and data for the 0-3 MeV (4 x 4 in. NaI(Tl)) and 0-8 MeV (1.5 x 1.5 in. NaI(Tl)) ranges.

61942 **(UCID—19567) General formalism for the study of activation: application to radiochemical detectors.** Poppe, C.H. (Lawrence Livermore National Lab., CA (USA)). 24 Sep 1982. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01. Order Number DE83000655.

This paper develops mathematical techniques required for the study of neutron-induced activation of importance to fission and fusion devices - reactors, nuclear weapons, etc. The formalism is presented as a guide for examining the dependence of activation products on flux time history, spatial gradients and the sensitivity to the assumed reactions and cross sections. Exact solutions in powers of the neutron fluence are presented and examined in various limits. As an example, radiochemical threshold (n,2n) detectors used to diagnose thermonuclear explosions are studied using approximations to these solutions. In particular, approximate formulas for the sensitivity of the radiochemical products to different cross sections are derived.

61943 **Response of a ^{3}He neutron spectrometer to 2-to 3-MeV neutrons.** Evans, A.E. Jr. (LANL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **38**: 582-584(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

61944 **Problems encountered in the use of plastic and chemical dose meters for plant commissioning.** Chu, R.D.H. (Atomic Energy of Canada Ltd., Ottawa, Ontario. Commercial Products). pp 97-100 of High-dose measurements in industrial radiation processing. Report of an advisory group meeting on standardization and high-dose intercomparison for industrial processing organized by the IAEA and held in Vienna, 25-29 September 1978. Vienna, Austria; International Atomic Energy Agency (1981).

From IAEA meeting on standardization and highdose intercomparison for industrial radiation processing; Vienna, Austria (25 Sep 1978).

The dosimetry performed at the commissioning of an industrial gamma sterilization plant must provide accurate and reliable information for determining the radiation performance characteristics in order that commercial sterilization can commence with a minimum of delay. Experience at the commissioning of 40 industrial gamma irradiators has shown that the combined use of plastic and chemical dose meters will give reliable results provided that sufficient controls are used. Errors can occur if reliance is placed solely on readings from a single dosimetry system calibrated under laboratory conditions.

61945 **Equivalent recoil area concept for delayed-neutron signal characterization.** Gross, K.C.; Strain, R.V. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **35**: 374-375(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

61946 **DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 1 - array studies.** Roberts, A. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979). 362p. (CONF-7808107—).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

Papers are presented concerning the design and implementation of the optical and acoustic sensors that will comprise the DUMAND (Deep Underwater Muon and Neutrino Detector) array. Specific topics include the results of experiments on atmos-

pheric muon and neutrino spectra obtained with various muon and neutrino spectrometers, optical sensors and arrays, optical data handling systems, the simulation of the sound generated by high-energy particles in water, constraints on acoustic arrays, standard ocean parameters for DUMAND calculations, and Monte Carlo investigations of hadronic and electromagnetic cascades in sea water.

61947 **Optical sensors and arrays.** Roberts, A. (Fermi National Accelerator Laboratory, Batavia, Ill.). pp 103-112 of DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 1 - array studies. Roberts, A. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

The use of optical sensors and arrays in the DUMAND experiment to detect the Cerenkov radiation produced by energetic charged particles in the ocean is discussed. Optical sensors which may be used in the array are either of the direct view type, in which Cerenkov light is detected by large-area photomultipliers, or wavelength-shifters, which allow the use of a much smaller photocathode area by increasing the wavelength of the light and trapping it by total internal reflection. Equal-intensity plots of Cerenkov radiation are presented which demonstrate the effects of attenuation by water and the angular distribution of light from a high-energy electromagnetic cascade. High-energy muon tracks are noted to have several components, including the Cerenkov cone of intensity, and bursts of ionization due to pair production, bremsstrahlung and nuclear interactions, implying that the sensor spacing in the array must be chosen so as to be able to observe the least luminous portions of the track in order to determine muon energy.

61948 **DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 3 - oceanographic and ocean engineering studies.** Wilkins, G. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979). 220p. (CONF-7808107—).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

The DUMAND (Deep Underwater Muon and Neutrino Detector) array, a hexagon 800 m on a side, 673 m high, and consisting of 22,698 sensor modules, is designed to detect neutrinos in the TeV range, hadronic cascades, muons and Cerenkov radiation. Its engineering, signal processing, and logistic aspects are considered, as are its optical detection (photomultiplier tubes) system and electronics. Geological and bottom current surveys were made at two proposed sites for the array (the Maui and Keahole Point basins of Hawaii), and a study of the steady-state response of a sensor string to current drag forces is reported. Biological interference with the DUMAND array, including mechanical entanglement by large animals, bioluminescence, and especially biofouling are considered, as well as the deployment, implantment and maintenance of the array.

61949 **The 1978 DUMAND 'standard' array.** Roberts, A. (Fermi National Accelerator Laboratory, Batavia, Ill.); Wilkins, G. (U.S. Naval Ocean Systems Center, Kailua, Hawaii). pp 9-22 of DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 3 - oceanographic and ocean engineering studies. Wilkins, G. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

The DUMAND (Deep Underwater Muon and Neutrino Detector) optical array is designed to detect neutrinos in the TeV range and above, their resulting hadronic cascades and fast muons and the Cerenkov radiation generated, and is heavily biased toward detecting neutrinos or muons entering the structure horizontally. The hexagonal array, 800 m on a side, with elements 673 m high, is based 50 m above the ocean floor, and will have 22,698 sensor modules containing up to 272,376 photomultiplier tube detectors. Signal processing considerations include locating the first major stage of computation at the intersection of the sensor plane and the support cable and placing the initial logic functions at the bottom of each riser cable, while a data computer (with above-threshold signal rates of 600/sec) in the array center will sense the entire 3-dimensional structure of the array.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 60757, 60763, 60772, 60788, 60813, 61048, 61453, 61762, 61832, 61833, 62007, 62470

61950 **(CONF-820807—4) Application of scanning electron microscopy and ultraviolet fluorescence to a study of Chattanooga Shale.** Harris, L.A.; Kopp, O.C.; Crouse, R.S. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1982. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01. Order Number DE82020912.

From 16. annual meeting of the Microbeam Analysis Society; Washington, DC, USA (9 Aug 1982).

Microanalytical techniques such as scanning electron microscopy, energy-dispersive x-ray analysis, and electron-beam microprobe analysis have been shown to be ideal for determining the host phases of the minor and trace elements in the Chattanooga shale. Positive correlations were found between pyrite and organic constituents. However, these observations provided no evidence that microorganisms acted as hosts for pyrite framboids. Interestingly, appreciable organic sulfur is still present, suggesting that the sulfur used for the formation of pyrite must have been derived mostly from other sources. It may be that the sulfate-reducing bacteria had an affinity for organic matter and that the organic fragments acted as substrates for pyrite growth.

61951 (INIS-SU—29, pp vp) **Method for designing digital meters of relative deviation of the pulse flux mean frequency.** Tesnavs, Eh.R.; Yanushkovski, V.A. 1979. (In Russian). Dep. NTIS (US Sales Only).

In Radiation technology.

Four methods for designing digital meters of relative deviation of mean frequency are considered it detail. These meters are intended to obtain information on deviation of a controlled parameter from the given values in absolute units or percentage. Corresponding flowsheets of frequency meters are presented. The suggested methods for designing frequency meters are attributed to cyclic meters. The problems of removing methodical error and widening the range of measuring frequency deviation from the nominal value, are discussed. It is noted, that using mainframe memory units and re-recording devices in frequency meters provides presentation of the measuring result of a previous cycle during the present cycle (the third and fourth variant of frequency meters).

61952 **(LA-UR—82-2476) Picotron 100 streak tubes as a 150-channel photometer.** Majumdar, S.; Weiss, P.B.; Black, J.P. (Los Alamos National Lab., NM (USA); Delta E Delta t Ltd., London (England); EG and G, Inc., Los Alamos, NM (USA)). 1982. Contract W-7405-ENG-36. 3p. (CONF-820822—11). NTIS, PC A02/MF A01. Order Number DE82021898.

From 26. technical symposium and exhibition of the International Society for Optical Engineering; San Diego, CA, USA (21 Aug 1982).

The characterization of a streak camera based upon Picotron 100 tube types is given. Both a large (30 cm 1 x 10 cm dia.) and a small (18 cm 1 x 5 cm dia.) version of this design has been tested. Over 150 channels of information are simultaneously time resolved with system S.N.R. of 3 at 100 picosecond time resolution without post intensification. Absolute photometric evaluation is given in the dynamic mode, i.e. while operating in the picosecond time domain. Such quantitative data has been lacking in the past, particularly for multiple channel applications.

61953 **(NASA-CASE-MFS—23775-1) Multi-channel temperature measurement amplification system.** Currie, J.R. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Aug 1981. 8p. US Patent and Trademark Office.

A number of differential outputs of thermocouples are sequentially amplified by a common amplifier. The amplified outputs are compared with a reference temperature signal in an offset correction amplifier, and a particularly poled output signal is provided

when a differential output is of a discrete level compared with a reference temperature signal.

61954 **(UCID—19542) Noise study of the digital seismic system amplifiers applied to earth noise measurements.** Valk, D. (Lawrence Livermore National Lab., CA (USA)). 31 Aug 1982. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01. Order Number DE82022035.

Portions of document are illegible.

Some major noise problems afflicting the Digital Seismic System are briefly examined for the purpose of improving the signal-to-noise ratio for earth noise measurements. After concluding that the Tustin Electronics Co. 1560 instrumentation amplifiers presently being used in the system obscure the earth noise data, a comprehensive study (part experimental and part theoretical) of amplifier noise is performed. Noise curves in the approximate frequency range of 0.01 to 50 Hz for the Tustin amplifiers as well as for a new design based on the PMI SSS725 operational amplifier are experimentally determined. The curves, which include noise current and noise voltage densities as well as total noise, are compared to each other, and to the Peterson low earth noise curve. The comparisons are done with amplifier inputs shorted, connected to one and then two 500-Ω seismometer data coils, and connected to one 20-kΩ seismometer data coil. The total noise curve of the new amplifier is found to shift further below that of the Tustin amplifier as data coil resistance is increased. A goal of lowering amplifier noise 10 dB or more below the Peterson earth noise power density curve for frequencies greater than .03 Hz is desired. The new amplifier design, used in conjunction with a 20-kΩ data coil, is found to satisfy this 10 dB or more signal-to-noise ratio for earth noise measurements. It is also found that the difference between earth noise and new amplifier noise magnitudes is increased as data coil resistance is increased.

61955 **Phase-locked yttrium iron garnet magnetometer for remote measurement of small field changes in a fluctuating background.** Carpenter, K.H.; da Silva, M.K. (Department of Electrical Engineering, University of Missouri-Rolla, Rolla, Missouri 65401). *Review of Scientific Instruments;* **53**: No. 9, 1414-1417(Sep 1982).

The ferromagnetic resonance frequency in small yttrium iron garnet (YIG) spheres placed in a rf filter structure is used to measure small changes in large magnetic fields in the presence of high-level random fluctuations of the background field. (Such measurements are needed for fusion plasma diagnostics.) This YIG magnetometer probe is driven by a microwave network analyzer whose working frequency is phase locked to the probe resonance, yielding an output frequency that is linearly related to the magnetic field magnitude. The YIG filter's phase response is used to control the system frequency, allowing measurement resolutions almost two orders of magnitude better than the YIG resonance 3 dB linewidth. Noise is effectively removed by the phase lock circuitry's low cutoff frequency and by time averaging using a frequency counter. Accuracy is essentially limited by the uncertainty in determining the constants in the linear field-frequency equation and by maintenance of constant temperature and magnetic field direction during incremental measurements.

61956 **Pulsed-laser time-of-flight atom-probe field ion microscope.** Tsong, T.T.; McLane, S.B.; Kinkus, T.J. (Physics Department, The Pennsylvania State University, University Park, Pennsylvania 16802). *Review of Scientific Instruments;* **53**: No. 9, 1442-1448(Sep 1982). Contract AC02-81ER10857.

A linear-type pulsed-laser time-of-flight atom probe has been developed. With a flight path length of ~200 and ~425 cm, the mass resolution is comparable to the energy focused time-of-flight atom probe of much more elaborate mechanical and electrical design. The isotopes of Mo, Xe, and W are completely separated to the roots of the mass lines. We also discuss how the mass resolution of the pulsed-laser atom probe can be further improved and where this instrument will be useful.

61957 **Surface probe for measurement of liquid contact in film and transition boiling on high-temperature surfaces.** Lee, L.; Chen, J.C.; Nelson, R.A. (Institute of Thermo-Fluid Engineering and Science, Lehigh University, Bethlehem, Pennsylvania 18015). *Review of Scientific Instruments;* **53**: No. 9, 1472-1476(Sep 1982). Contract AC07-76ID01570.

A microthermocouple probe to detect liquid contacts on a high-temperature surface during film and transition boiling regimes is described. Experiments indicate the probe and its associated data recording and processing circuits have sufficiently rapid response to provide quantitative measurements of individual liquid contacts, permitting calculations of contact frequencies and durations, and of average vapor versus liquid contact time fractions. Initial experimental results for pool boiling of saturated water at atmospheric pressure, in the quenching of a high-temperature copper block, indicated that the liquid contact time fraction increased from 10% to 65% in 7 s as the block surface temperature cooled from 483 to 418 K.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 60867, 60870

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 61880

61958 **(LA—9271-MS) High-explosives test facility.** Martinez, E.C.; Goforth, J.H. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 20p. NTIS, PC A02/MF A01. Order Number DE82021219.

This report describes a high explosives test facility that makes efficient use of equipment and combines utility, convenience, and safety in a modest amount of space. It is a dedicated facility for exploratory development efforts that previously were conducted in a single room having very limited capabilities. Two explosives testing areas are now available and several projects are supported concurrently.

61959 **(LA—9489-MS) Attempts at ultraviolet laser initiation of nitromethane and PETN.** Dick, J.J. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01. Order Number DE82021253.

The object of the experiments was to check the feasibility of detonation initiation by direct photolytic decomposition of explosive molecules and subsequent chain reaction. Excimer lasers with wavelengths from 193 to 308 nm were used to deposit several tenths of joule of energy in nitromethane and PETN in about 40 ns. Our attempts to achieve initiation are reported. Initiation of detonation was not attained in these experiments. Reasons for this are explored.

61960 **(MHSMP—82-26) Large-scale ODTX standard test. Process development endeavor No. 301.** Schmitz, G.T.; Faubion, B.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Aug 1982. Contract AC04-76DP00487. 14p. NTIS, PC A02/MF A01. Order Number DE82022247.

A standard ODTX test configuration was designed and proven for 12.7 mm dia. x 50.8 mm long and 25.4 mm dia. x 76.2 mm long test samples. The results from plastic-bonded explosives (LX-10, PBX 9501, X-0298, PBX 9502, RX-26-AF and PBX 9502) suggest a shortened sample and larger heater contributed to achieving a near isothermal test environment. The ODTX test is used to establish safe pressing temperatures for large explosive parts.

61961 **(MHSMP—82-27) Skin sensitivities of LX-10 and LX-14 as functions of billet weight. Process development endeavor No. 301.** Crutchmer, J.A.; Ashcraft, R.W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Sep 1982. Contract AC04-76DP00487. 28p. NTIS, PC A03/MF A01. Order Number DE82021305.

Skid sensitivity as a function of billet weight was determined using large-scale sensitive pole billets of both LX-10 and LX-14. Billet weights were 18, 36 and 57 kg. Tests were conducted at two impact angles, 14° and 45°. Results indicate that skid sensitivity increases with billet weight. Prediction models for both explosives were derived from the experimental data.

61962 **(SAND—82-1816C) Blast predictions for Coyote Canyon explosions.** Reed, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 33p. (CONF-820842—1). NTIS, PC A03/MF A01. Order Number DE82019485.

From 20. DOE seminar on explosive safety; Norfolk, VA, USA (24 Aug 1982).

In order to conduct tests of small explosives (up to 7.5 tons of TNT) on the Kirkland Air Force Base without damaging nearby structures or seriously disturbing neighbors, explosive yield limits have been developed for no damage regardless of weather conditions and for keeping the sonic effects below the threshold of general audibility. In addition, an up-to-date blast prediction procedure, based on locally available weather data and forecasts, was developed for use by USAF meteorologists. The data used, development methods, and results are presented. (LCL)

61963 **(SRI-PYU—3341) Experimental extinguishment of fires by blast. Final report.** Backovsky, J.; Martin, S.; McKee, R. (SRI International, Menlo Park, CA (USA)). May 1982. 93p. Federal Emergency Management Agency, 1725 I Street, N.W., Washington, DC 20472.

Experiments on extinction of fires by airblast were continued in the shocktube facility dedicated to blast/fire interactions studies, and the facility was further improved toward a full, thermal/blast simulation capability, which will include a thermal radiation source. The experimental efforts were aimed toward improving our understanding of the physical mechanisms and scaling rules of blast extinguishment of fires through (1) tests with various common liquid (class B) fuels of different physicochemical properties and burning behavior and (2) tests with wood cribs of various element (stick) thicknesses and consequently varying burning behavior and time scales. Limited shocktube tests were also conducted in preparation for the MILL RACE event featuring blast extinction of fires on cellulosic debris. The significance of fuel type in ease of extinction by short positive-phase-duration airblast was confirmed. Most notable is that many class B fuels may have a significantly lower extinction-threshold overpressures, even with the short-duration airblasts used, than past tests with hexane had indicated. All tests indicated that flame flashback to the fuel bed from the downstream turbulent wake was the flame-retaining mechanism in nonextinction cases.

4502 Nuclear

REFER ALSO TO CITATION(S) 62340

61964 **(AD-A—112420/5) Comparison of Mount Saint Helens volcanic eruption to a nuclear explosion. Technical note.** Gould, K.E. (DOD Nuclear Information Analysis Center, Santa Barbara, CA (USA)). 1 Jan 1981. 27p. (DASIAC-TN—80-3). NTIS, PC A03/MF A01.

The phenomena and effects of airblast, ground shock, thermal radiation, cratering and ejecta, and debris cloud and deposition from the eruption of Mt. St. Helens were compared to those that would result from a nuclear explosion to determine if phenomena or effects were analogous and thus might provide useful data for military nuclear weapon effects studies. It is concluded that the phenomena are not analogous. In particular, airblast destruction was caused by clouds of ash driven by subsonic winds, rather than by a supersonic shock wave that would be the damage mechanism of a nuclear explosion. Because of the lack of analogy between the eruption and nuclear explosion phenomena, it appears questionable that any of the effects are analogous; therefore, it is unlikely that anything more of military interest can be gained from studying the effects of the eruption. However, key contacts for further information on the eruption and the associated research studies are given. The comparison of the eruption of Mt. St. Helens to the explosion of a 10- to 20-megaton nuclear weapon is misleading. Such comparisons serve no useful purpose and should be avoided.

61965 **(CONF-821005—8) Gnome site decontamination and decommissioning project.** Orcutt, J.A.; Sorom, E.R. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Aug 1982. Contract AC08-76NV00410. 4p. NTIS, PC A02/MF A01. Order Number DE82020396.

From DOE international decommissioning symposium; Seattle, WA, USA (10 Oct 1982).

In July 1977, DOE/Headquarters directed DOE/NV to design a decontamination and decommissioning plan for the Gnome site, 48 kilometers southeast of Carlsbad, New Mexico. The plan incorporated three distinct phases. During Phase I, both aerial and ground radiological surveys were conducted on the site. Radiological decontamination criteria were established, and a decontamination plan was developed based on the radiological survey results. During Phase II, site preparatory and rehabilitation work was completed. The actual land area decontamination was accomplished during Phase III with conventional earthmoving equipment. A gravity water injection system deposited 36,700 metric tons of contaminated soil and salt in the Gnome cavity. After completion of the decontamination and decommissioning operations, the Gnome site was returned to the Bureau of Land Management for unrestricted surface use.

61966 **(UCID—19543) Underground nuclear explosions at Astrakhan, USSR.** Borg, I.Y. (Lawrence Livermore National Lab., CA (USA)). 13 Aug 1982. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01. Order Number DE82021358.

The three underground nuclear explosions recorded in 1980 and 1981 by Hagfors Observatory in Sweden are in the vicinity of Astrakhan on the Caspian Sea. They are believed to be associated with the development of a gas condensate field discovered in 1973. The gas producing horizons are in limestones at 4000 m depth. They are overlain by bedded, Kungarian salts. Salt domes are recognized in the area. Plans to develop the field are contained in the 11th Five Year Plan (1981-82). The USSR has solicited bids from western contractors to build gas separation and gas processing plant with an annual capacity of 6 billion m^3. Ultimate expansion plans call for three plants with the total capacity of 18 billion m^3. By analogy with similar peaceful nuclear explosions described in 1975 by the Soviets at another gas condensate field, the underground cavities are probably designed for storage of unstable, sour condensate after initial separation from the gaseous phases in the field. Assuming that the medium surrounding the explosions is salt, the volume of each cavity is on the order of 50,000 m^3.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 62192

61967 **(UCID—19493) Empirical analysis of seismic records for eleven nuclear tests at the Nevada Test Site.** Younker, J.L.; Springer, D.L.; Vergino, E.S. (Lawrence Livermore National Lab., CA (USA)). 9 Aug 1982. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01. Order Number DE82021686.

Portions of document are illegible.

Regional seismic records for eleven underground nuclear explosions were processed and analyzed (empirically) in a search for source and path related patterns in the signals. These nuclear tests were conducted between August, 1979 and April, 1980; all were located in Yucca Flat at the Nevada Test Site (NTS). The seismic signals generated by these explosions were recorded on the LLNL four-station network, located at distances of 200 to 400 km from the NTS. Amplitudes were measured for consistently recorded vertical component body waves, and for vertical and transverse components of surface waves. Correlation between phase amplitudes was

statistically determined, and amplitude ratios were compared for four stations for the same event, and at a single station for the complete set of events. Previous studies have shown that certain amplitude ratios are relatively unaffected by the size of the explosion but sensitive to propagation effects. For this set of events, we do not find a statistically significant change in the ratio of Pg:Lg due to different propagation paths to the four stations. We do, however, find increased variability in the amplitude measurements for the smaller events in the population considered in this study.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 61988, 62015, 62027, 62028, 62029, 62159

61968 (CONF-8106214—) **Carbon dioxide effects research and assessment program.** Beatty, N.B. (ed.). (Oak Ridge Associated Universities, Inc., TN (USA)). 1981. Contract AC05-76OR00033. 554p. NTIS, PC A24/MF A01. Order Number DE82016633.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Chapter titles are: the first detection of carbon dioxide effects; the atmosphere; the polar regions; the oceans; and the biosphere. Sixteen papers were abstracted and indexed individually for EDB/ERA. (JGB)

61969 (CONF-8106214—, pp 57-77) **Role of atmospheric models in the detection of the first climatic effects of increased CO_2.** Gates, W.L. (Oregon State Univ., Corvallis). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Some of the more important issues in the application of atmospheric models to the CO_2-climate question are identified, and to the further research needed for their effective application in the detection of the first climatic effects of increasing atmospheric CO_2 is indicated. Discussion centers on the use of comprehensive atmospheric general circulation models (GCMs) that resolve the three-dimensional structure of the transient cyclonic-scale eddies. The GCMs offer the best possibility of realistically portraying the effects of CO_2 on regional climatic variables. Results of model experiments are described.

61970 (CONF-8106214—, pp 79-94) **Seasonal and latitudinal variation of the CO_2-induced change in a climate of an atmosphere-mixed-layer ocean model.** Manabe, S.; Stouffer, R.J. (Princeton Univ., NJ). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Results from a CO_2-climate sensitivity study with an atmosphere-mixed-layer ocean model are described. The climate change resulting from an increase of atmospheric CO_2 concentration has substantial latitudinal and seasonal variation. The main emphasis of this study is on the latitude-time distributions of the CO_2-induced changes of the selected climatic variables. In order to evaluate the detectability of these changes, the ratio of a CO_2-induced change to a standard deviation of the temporal fluctuation (signal-to-noise ratio) is computed for these climatic variables.

61971 (CONF-8106214—, pp 95-141) **First effects detection in atmospheric general circulation and air-sea interaction.** Newell, R.E. (Massachusetts Inst. of Tech., Cambridge). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Various approaches to the numerical modeling of parameters affected by atmospheric CO_2 concentrations are discussed. Of basic interest is the effect that increased carbon dioxide may have on the water cycle. The approach is to examine factors that control atmospheric temperature, sea-surface temperature and air-sea interaction, atmospheric circulation and oceanic circulation, to see which may change when carbon dioxide increases, and to see how past data may influence the search for future changes. Recommendations are made for future research.

61972 (CONF-8106214—, pp 143-158) **Signal-to-noise ratios for surface-air temperature and the detection of CO_2-induced climatic change.** Wigley, T.M.L.; Jones, P.D. (Univ. of East Anglia, Norwich, England). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Although increasing atmospheric CO_2 levels will probably cause a significant global warming, the effects are not yet detectable because of the noise of natural climatic variability. A statistical definition for noise is given, and signal-to-noise ratios are calculated for surface-air temperatures using the model results of Manabe and Stouffer (1980) to determine the signal and grid-point temperature data to determine the noise. An examination of the spatial and seasonal distribution of signal-to-noise ratio shows that the highest values occur in summer and in annual mean surface temperatures averaged over the Northern Hemisphere or over mid-latitudes. The spatial and seasonal characteristics of the warming that occurred in the early decades of this century are examined and found to be similar to the expected CO_2 signal. This similarity between the low-frequency component of natural climatic variability and the expected CO_2 signal may hinder the early detection of CO_2 effects on climate.

61973 (CONF-8106214—, pp 165-174) **Statistical methodology for first detection of carbon dioxide effects in the atmosphere.** Murphy, A.H.; Katz, R.W. (Oregon State Univ., Corvallis). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

The available statistical methodology for the detection of climatic change is discussed. An important distinction is drawn between two different types of statistical problems: problems based on data from controlled experiments, and problems based on data from uncontrolled observational studies. The second type of statistical problem is the detection of climatic change using historical time series of climatic observations. The ways in which the additional difficulties introduced by uncontrolled studies might require more complex statistical procedures than those for controlled experiments are examined in this paper. Following this, a strategy is proposed for testing for climatic change, including the specific statistical methodology that could be applied. The manner in which the more difficult question of attributing any climatic changes that might be detected to carbon dioxide increases is then discussed. Potential strategies might involve the reliance on climate model results to determine whether the observed effects on several different climatic variables are consistent with atmospheric theory. The basic characteristics of the climatic data base, with emphasis on the limitations that this data base might impose on the scope of the analysis, are also mentioned.

61974 (CONF-8106214—, pp 175-194) **Detecting climate effects of increasing atmospheric carbon dioxide.** Klein, W.H. (Univ. of Maryland, College Park). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

In order to detect first climate changes caused by the upward trend in CO_2, an extensive research program is needed in three general areas: numerical modeling, direct measurements, and statistical analysis. Each of these areas is discussed in a separate section. This discussion is followed by a suggestion to develop a statistical model that may remove some of the natural variability from the observed temperature record and more clearly identify the CO_2 signal.

61975 (CONF-8106214—, pp 207-236) **Snow and ice indicators of possible climatic effects of increasing atmospheric carbon dioxide.** Barry, R.G. (Univ. of Colorado, Boulder). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Research on possible cryogenic changes associated with a CO_2-induced warming of the earth is reviewed, with emphasis on that concerning the possible disappearance of the Arctic pack ice and on the disintegration of the West Antarctic Sheet. Effects of CO_2 on the cryosphere are discussed, and the expected responses of snow cover, sea ice, permafrost, ice sheets, and alpine and polar glaciers described. It is concluded that a CO_2-induced warming on the century time scale will have only minor consequences for ice sheets and ground ice or permafrost. Nevertheless, possible changes in ice sheet accumulation rates should be monitored at regular intervals, at least every 5 years, for large-scale transects across key areas in Antarctica and Greenland.

61976 (CONF-8106214—, pp 343-359) **Rise of global mean sea level as an indication of climate change.** Etkins, R. (National Oceanic and Atmospheric Administration, Rockville, MD); Epstein, E.S. 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Rising mean sea level, it is proposed, is a significant indication of global climate change. The principal factors that have contributed to the observed increases of global mean sea level in recent decades are thermal expansion of the oceans and the discharge of polar ice sheets. Our calculations indicate that thermal expansion alone cannot explain the observed rise in sea level over the last 40 years; significant discharges of polar ice must be occurring. Global warming, due in some degree presumably to increasing atmospheric CO_2, has been opposed by the extraction of heat necessary to melt the discharged ice. During the past 40 years more than 50,000 cubic kilometers of ice have been discharged and have melted, reducing the surface warming that might otherwise have occurred by as much as a factor of two. The transfer of mass from the polar regions to a thin spherical shell covering all the oceans should have increased the earth's moment of inertia and correspondingly reduced the speed of rotation by about 1.5 parts in 10^8. This accounts for about three quarters of the observed fractional reduction in the earth's angular velocity since 1940. Recommendations are made for future research.

61977 (CONF-8106214—, pp 385-418) **Early indications of CO_2 warming in northern sea-surface temperature.** Bell, P.R. (Oak Ridge Associated Universities, TN). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Detection of a change in sea-surface temperature (SST) is discussed as a method for an early warming of the CO_2 heating effect on the earth and its atmosphere. Interfering effects that must be contended with are to a considerable degree cyclical; irregular changes due to the cooling effects of volcanic aerosols in the stratosphere are independently measurable. An example of the complex and iterative analysis process that can be used to separate the secular trend from interfering signals is given. It is concluded that results of this analysis are a preliminary indication of the presence of CO_2 warming.

61978 (CONF-8106214—, pp 459-502) **Detection of the first ecological effects in polar tundra regions resulting from an increase in atmospheric carbon dioxide concentration: suggestions for research.** Miller, P.C. (San Diego State Univ., CA). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Polar tundra regions are important in the global carbon balance and may respond to changes in atmospheric carbon dioxide more than temperate and tropical ecosystems. Climates in high latitudes are expected to change more than climates at low latitudes. Arctic plant and animal populations are dominated by the physical environment, especially temperature. Arctic and taiga ecosystems contain large quantities of carbon in the seasonally thawed layer and in the permafrost. The peat and pollen records contained in the accumulated organic matter can be used to reconstruct past climates. Future changes in ecosystem properties can indicate future climatic and CO_2 effects. the detection of CO_2-induced change involves detecting an ecological change within a relatively short period and establishing that the change is due to carbon dioxide effects and not to unrelated temperature or pollution effects. A network of seven North American monitoring sites is suggested, four in the Arctic and three in the taiga. Variables, which are differentially sensitive to carbon dioxide, temperature, and sulfate and nitrogen pollutants, are suggested for monitoring. Reconstruction of past climate from permafrost temperature profiles, peat profile analyses, and woody plant growth rings should be carried out. Laboratory and field experiments should be carried out to establish causal relations between the observed ecological changes and carbon dioxide, temperature, and pollutants. The program should be planned for 20 years but specific recommendations are made for only 7 years.

61979 (CONF-8106214—, pp 533-540) **Measurement of climatic changes caused by the increase in atmospheric CO_2: the role of the biota.** Woodwell, G.M.; Houghton, R.A. (Marine Biological Lab., Woods Hole, MA). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

Studies on the role of the biota in affecting the CO_2 content of the atmosphere and other physical and chemical attributes of the earth's surface are reviewed. the reduction of biota and soils on a global basis puts additional CO_2 into the atmosphere. It is pointed out that changes in the biota are clearly important, but they do not offer an opportunity to make sensitive, early measurements of climatic changes. They emphasize that any prediction of the future CO_2 content of the atmosphere will require additional, even more accurate, appraisal of the biotic contribution, and that any solution to the problem will be based in large part on the management of forests and their soils.

61980 (NASA-CR—168417) **Effects of multiple scattering and surface albedo on the photochemistry of the troposphere. Final report, period ending 30 Nov 1981.** Augustsson, T.R.; Tiwari, S.N. (Old Dominion Univ., Norfolk, VA (USA)). Dec 1981. 264p. NTIS, PC A12/MF A01.

The effect of treatment of incoming solar radiation on the photochemistry of the troposphere is discussed. A one dimensional photochemical model of the troposphere containing the species of the nitrogen, oxygen, carbon, hydrogen, and sulfur families was developed. The vertical flux is simulated by use of the parameterized eddy diffusion coefficients. The photochemical model is coupled to a radiative transfer model that calculates the radiation field due to the incoming solar radiation which initiates much of the photochemistry of the troposphere. Vertical profiles of tropospheric species were compared with the Leighton approximation, radiative transfer, matrix inversion model. The radiative transfer code includes the effects of multiple scattering due to molecules and aerosols, pure absorption, and surface albedo on the transfer of incoming solar radiation. It is indicated that significant differences exist for several key photolysis frequencies and species number density profiles between the Leighton approximation and the profiles generated with, radiative transfer, matrix inversion technique. Most species show enhanced vertical profiles when the more realistic treatment of the incoming solar radiation field is included

61981 **A simple model for wind field computation from sparse data.** Lee, W.H. (LASL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **35**: 50-52(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 60802, 60824, 60836, 61675, 61750, 61838, 61848, 61968, 61971, 61974, 62017, 62054, 62159, 62162, 62164, 62165, 62173, 62185

61982 (AD-A—114161/3) **Laser propagation research. Volume II. Gaseous and particulate characterization of the atmosphere. Technical report Mar-Oct 80.** Flowers, W.L. (Optimetrics, Inc., Ann Arbor, MI (USA)). Nov 1980. 25p. NTIS, PC A02/MF A01.

An existing Fourier Transform Spectrometer (FTS) data base of slant path atmospheric transmission spectra using the sun as a source is described. Recent improvements to the FTS measurements system are discussed and results of pyroelectric radiometer measurements of slant path solar transmission are reviewed. Techniques for atmospheric absorbing gas vertical density profile extraction are presented and results of model comparisons with FTS data are reviewed. Recent measurements of H2O, N2O, THC, CH4, O3, and CO2 atmospheric concentrations at the ARKY and NOP sites at WSMR are presented and discussed. Results of aerosol particulate distribution and mass loading measurements at the WSMR-NOP sites are presented and described.

61983 **(AD-A—114162/1) Laser propagation research. Volume II. Gaseous and particulate characterization of the atmosphere. Appendix A-1. Plots of measured atmospheric gas concentrations - ARKY site.** Flowers, W.L. (Optimetrics, Inc., Ann Arbor, MI (USA)). Nov 1980. 56p. NTIS, PC A04/MF A01.

Contents: Plots of measured Atmospheric gas concentrations - ARKY SITE; Water vapor partial pressure measurements at ARKY site during the period 26 March -21 August 1980; Nitrous Oxide plots - Concentration measurements at Arky site during the period 26 March-10 June 1980; Carbon Dioxide measurements at ARKY site for 25 March-21 August 1980; Ozone and totally hydrocarbon measurements at ARKY site during the period 4 June-21 August 1980; and Ozone measurements at ARKY site during the period 25 March-20 August 1980.

61984 **(AD-A—114163/9) Laser propagation research. Volume II. Gaseous and particulate characterization of the atmosphere. Appendix A-2. Plots of measured atmospheric gas concentrations. NOP site.** Flowers, W.L. (Optimetrics, Inc., Ann Arbor, MI (USA)). Nov 1980. 73p. NTIS, PC A04/MF A01.

Contents: Plots of Measured Atmospheric Gas Concentrations NOP Site; Water vapor measurements at NOP Site during the period 10 April-28 April 1980; Nitrous oxide measurements at NOP site during the period 10 April-28 April 1980; Total Hydrocarbon measurements at NOP site during the period 22-24 April 1980; Carbon dioxide measurements at NOP site during the period 10 April-28 April 1980; and Ozone concentration measurements at NOP site during the period 10 April-28 April 1980.

61985 **(AD-A—114164/7) Laser propagation research. Volume II. Gaseous and particulate characterization of the atmosphere. App. A-3. Maximum, mean and minimum values of measured gas concentrations at NOP site. App. A-4. Plots of nephelometer and aerosol mass monitor data at ARKY site. App. A-5. Plots of aerosol mass monitor data at the NOP site.** Flowers, W.L. (Optimetrics, Inc., Ann Arbor, MI (USA)). Nov 1980. 28p. NTIS, PC A03/MF A01.

Contents: Maximum, mean and minimum values of measured gas concentrations at NOP site; Maximum, mean, and minimum values of water vapor concentrations measured at NOP site during the period 10 April-28 April 1980; Maximum, mean and minimum values of carbon dioxide concentrations measured at NOP site during the period 10 April-28 April 1980; Maximum, mean and minimum values of Ozone concentration measured at NOP site during the period 10 April-28 April 1980; Plots of nephelometer and aerosol mass monitor data at ARKY site; and Plots of aerosol mass monitor data at the NOP site.

61986 **(CISE—1685) PIXE and its application to the element analysis of Milan air particulate matter.** Caruso, E.; Marcazzan, G.M.; Redaelli, P. (Centro Informazioni Studi Esperienze, Milan (Italy)). 1981. 20p. NTIS, PC A03/MF A01.

The features of the Particle Induced X-ray Emission (PIXE) system using the proton beam of the tandem Van de Graaff accelerator are described. The system was calibrated for quantitative analyses, its reliability was verified, and its advantages were compared with other techniques. The main advantage of the PIXE system is shown to be in the analysis of microquantities of matter. The system was used in the study of the atmospheric aerosol of Milan. Average element concentrations and their daily and seasonal variations are given along with particle size distributions.

61987 **(DOE/EV/10019—2-Vol.2-Pt.17) Use of paleoclimatic data in understanding and possibly predicting how CO_2-induced climatic change may affect the natural biosphere. Volume II, Part 17. Environmental and societal consequences of a possible CO_2-induced climate change.** Webb, T. III. (Brown Univ., Providence, RI (USA). Dept. of Geological Sciences). Jul 1982. Contract AS01-79EV10019. 25p. NTIS, PC A02/MF A01. Order Number DE82020579.

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This paper summarizes work and recommendations of over 500 authors and reviewers. Studies in three main Research Areas need to be organized and funded to document past changes in climate to help in predicting how future changes may affect the biosphere. The three areas identified for research were: Research Area I, in which paleoclimatic data will be used to test the results of computer-based climatic models; Research Area II, in which paleoclimatic data will be used to map past patterns of climatic change; and Research Area III, in which paleoclimatic data will be used to document past biospheric changes induced by past climatic changes. (PSB)

61988 **(DOE/NBM—2020919) Nature of, and the formaldehyde off-gassing characteristics of, urea-formaldehyde foam insulation (UFFI). Final report to the Canadian Department of Consumer and Corporate Affairs: Product Safety Branch.** Gammage, R.B. (Oak Ridge National Lab., TN (USA)). 30 Jul 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE82020919.

This report is divisible into the following four sections that pertain to the nature, application, and performance of urea-formaldehyde (UF) resins and foams in regard to their formaldehyde outgassing characteristics: elements of basic chemistry that affect hydrolysis and stability; pertinent experimental findings of several studies on the release of formaldehyde from urea-formaldehyde foam insulation (UFFI); studies that model the diffusion of formaldehyde through drywall and correlate the rate of formaldehyde emission with the air exchange rate and the concentration of formaldehyde; and, viability of materials and equipment for the controlled production of UFFI. Results indicate that UFFI is a complex and intrinsically unstable material that releases formaldehyde over long-time periods. Even the best foams available in the US, prepared from low formaldehyde resins according to eight different manufacturers' specifications, have abundant potential for long-term or chronic release of formaldehyde. At the present time it is not possible to state that UFFI is a material whose long-term formaldehyde release characteristics can be adequately controlled or predicted.

61989 **(ENICO—1116-Suppl.1) June 1982 effluent monitoring report.** Honkus, R.J. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Aug 1982. Contract AC07-79ID01675. 34p. NTIS, PC A03/MF A01. Order Number DE82021597.

The effluent monitoring program for June 1982 is summarized. There have been no significant or unplanned releases to data in CY-1982. (ACR)

61990 **(EPRI-EA—1904) Sulfate Regional Experiment: data base inventory and summary of major index file programs. Interim report.** Mueller, P.K.; Hidy, G.M. (Environmental Research and Technology, Inc., Westlake Village, CA (USA)). Aug 1982. 113p. NTIS, PC A06/MF A01. Order Number DE82906472.

This report provides a detailed description of the composition and format of the SURE data base and is meant to be a supplement to Section 4 of the Sulfate Regional Experiment, Report of Findings, EPRI Report EA-1901. It is the purpose of this document to provide a prospective user of the SURE data base with a listing of the percent data capture of the currently available validated data by site and month for each observable, a summary of major files and programs used to access and manipulate the data, and a format description of all data files incorporated into the data base. A prospective user may request data from four categories: ground station monitored air quality data, aircraft monitored air quality data, upper air and surface meteorological observations, and the emissions inventory compiled for the SURE region.

61991 (EPRI-EA—1907) Sulfate Regional Experiment: regional air-quality-modeling documentation. Interim report. Mueller, P.K.; Hidy, G.M. (Environmental Research and Technology, Inc., Westlake Village, CA (USA)). Aug 1982. 185p. NTIS, PC A09/MF A01. Order Number DE82906473.

Documentation is provided for the Sulfate Regional Advection and Diffusion Scheme (SURADS). Important factors in three of the SURADS model components are described. In particular, parts of the Meteorological Discretization System (MDS), the Air Quality Initialization System (AQIS), and the Numerical Integration System (NIS) of the SURADS are detailed. In the MDS, temporally and spatially varying vertical eddy diffusivity is determined from wind speed, surface temperature, temperature soundings, and surface roughness. Wind fields at five levels in the vertical are interpolated each hour from twice-daily rawinsonde data. Calculations of winds required that the horizontal divergence be minimized to approach zero in each level of the wind field while the vorticity is maintained. The practical considerations for using chemical reactions of different complexity in regional models are discussed with application to the AQIS. Because of limitations in detailed information about heterogeneous processes, the AQIS development concentrated on homogeneous gas phase reactions for sulfur dioxide oxidation. A detailed mechanism for homogeneous oxidation chemistry containing 66 reactions of 34 species was used to estimate the SO_2 oxidation rate for incorporation into the regional modeling. The homogeneous mechanism provided a diurnal oxidation rate schedule adopted for summer cases, but yielded theoretical rates which were too low to be consistent with winter conditions. Instantaneous conversion rates as high as 6 percent per hour were found for summertime conditions. Theoretical reaction rates varied considerably with reactive hydrocarbon and nitrogen oxide ratios, solar intensity (which depends on time of day, season of year, and cloud cover), temperature, water vapor concentration, and elevation.

61992 (LBL—14235) Predicting a continuous spatial variable from discrete-point measurements. Johnson, L.D.; Merrill, D.W.; Selvin, S. (Lawrence Berkeley Lab., CA (USA)). Mar 1982. Contract AC03-76SF00098. 16p. NTIS, PC A02/MF A01. Order Number DE82021684.

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Results obtained by estimation of an average level of atmospheric pollution for an area based on point data derived from monitoring stations may be seriously biased as an estimator of the mean level of pollution. An alternative is to fit an interpolating surface to the data values and find its average. A very simple way to smooth or interpolate is to calculate the value of a surface as a weighted average of the values at the data points. This method is called a moving average. Criteria are imposed so that the surface is smooth at the data points. These weights are chosen as a function of the distance between the data points and the estimation point. The method of estimation used in this study is a weighted mean (i.e., an arithmetic mean of the logarithm of the geometric mean concentrations) and therefore is an example of a moving average. Three air pollutant monitoring stations in different geographic locations were used for the study. These stations measure pollution a certain percentage of the time and are stationary in that the measurement is always taken at the same latitude and longitude. At each station a log normal distribution is implicitly assumed. A relevant statistical problem is determining the fitness of the estimate and is a major part of the study. For determining the fitness, each station's value was estimated from surrounding stations' observed values, and this estimate was compared with the observed value. The methodology described is an explicit calculation, not a fit, and so is not affected by ill-defined boundary conditions and other uncertainties. Initial results are reported.

61993 (ORAU/IEA—82-6(M)) Methane hydrates: an estimate of their contribution to CO_2-induced atmospheric warming. Bell, P.R. (Oak Ridge Associated Universities, Inc., TN (USA)). Aug 1982. Contract AC05-76OR00033. 30p. NTIS, PC A03/MF A01. Order Number DE82021950.

Methane hydrate (a clathrate compound of ice and methane) is widespread in cold regions of the earth below permafrost and in seafloor sediments. We examine a suggestion by G.J. MacDonald that decomposition of these compounds with release of methane could contribute a positive feedback to the CO_2 warming. Although very large amounts of these hydrates probably exist, most of them are buried deep enough to be immune to heating of a few hundred years' duration or are sufficiently deep in the oceans that there will be insufficient heating for release. A small fraction (~ 1%) of the methane hydrate is situated at a depth of about 300 meters in the Arctic Ocean where it will be vulnerable to decomposition with temperature changes that may accompany a doubled-CO_2 warming. This release might average 8 gigatons of carbon per year over about 100 years.

61994 (PB—82-189556) Suspended particulate matter: a report to Congress. Final report. Adamson, L.F.; Bruce, R.M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Feb 1979. 87p. (EPA—600/9-79-006). NTIS, PC A05/MF A01.

This report is in response to Section 403(a)(1) of the Clean Air Act as Amended August 1977. The report covers: (1) a review of the physical and chemical characteristics of airborne particles (source, composition, and sampling site as related to size); (2) a review of the effects of particulate matter on public welfare (ecological, materials, atmospheric, aesthetic); (3) the status of human exposure to airborne particles as related to source; and (4) a review of the effects of airborne particles on human health (lung deposition, chemical composition, interactions, and potentiating conditions). Although there is a wide divergence of opinion among experts and scientific groups with respect to the issues of particulates (cf. Appendix A), the following can be concluded from the available information: (1) High levels of airborne particles have been associated with episodes of high pollution during the past, especially in the United Kingdom and the United States. (2) Although pollution levels have declined in many U.S. localities in recent decades, there is still need for improvement in several of our cities. (3) Additional research is needed to improve the scientific basis for future airborne particle standards as outlined by EPA (cf. Dr. Cortesi in the Culver Pilot Study of Particulate Matter).

61995 (PB—82-189614) Iowa air quality report 1980. (Iowa Dept. of Environmental Quality, Des Moines (USA). Air and Land Quality Div.). Jul 1981. 70p. NTIS, PC A04/MF A01.

Iowa's air monitoring data from 1957 to 1980 have been compiled in this report for seven pollutants monitored in the State: suspended particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, hydrocarbons, ozone and lead. The data are presented in tabular form for each pollutant. Additional sections discussing the pollutants and pollutant sources, the air monitoring network, and the analysis of data and trends have been added.

61996 (PB—82-190067) Health hazard evaluation report No. HHE-80-033-815, Asarco, Inc., Hayden, Arizona. Apol, A.G.; Coye, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Feb 1981. 16p. (HHE—80-033-815). NTIS, PC A02/MF A01.

Worker exposures to arsenic (7440382) (As), cadmium (7440439) (Cd), copper (7440508) (Cu), lead (7439921) (Pb) and sulfur-dioxide (7446095) (SO2) were surveyed at ASARCO, Incorporated (SIC-3331) in Hayden, Arizona on April 23 and 24, 1980. The evaluation was requested by an authorized representative of the United Steel Workers, Local 886, on behalf of an unspecified number of workers. Personal and area air samples were collected in the pug mill department, and workers were tested for blood Pb and urinary As concentrations. All four personal samples for As exceeded the OSHA standard of 10 micrograms per cubic meter, one sample exceeded the Cu dust standard of 1 milligram per cubic meter (mg/cu m), and one sample exceeded the Pb standard of 50 micrograms per cubic meter. Exposures to Cd fume, Cd dust, and SO2 were below the respective OSHA standard of 0.2mg/cu m, 1.0mg/cu m, and 5 parts per million. One worker had a urinary As concentration that exceeded 100 micrograms per liter, and two others had urinary As concentrations greater than 50 micrograms per 100 milliliters. The authors conclude that no excessive Pb exposure exists, but one worker may be exposed to hazardous As con-

centrations. They recommend that OSHA regulations regarding exposures to As and Pb be consulted, equipment be properly maintained, ventilation be provided, urine sampling be conducted periodically, and workers be educated about the health hazards related to As and Pb.

61997 **(PB—82-201773) Determination of a range of concern for mobile source emissions of hydrogen sulfide. Technical report.** Harvey, C.A. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jan 1982. 38p. NTIS, PC A03/MF A01.

This report describes an effort by the Emission Control Technology Division of the Environmental Protection Agency to establish a range of concern for hydrogen sulfide (H2S) emissions from mobile sources. Mathematical models that were previously designed for various exposure scenarios (such as enclosed spaces, expressways, and street canyons) were used to calculate the ambient air concentrations resulting from various mobile source hydrogen sulfide emission factors (grams/mile). In conjunction, with this, a literature search was conducted by Midwest Research Institute under contract to EPA to aid in the determination of the final range of concern. The results of this analysis provide a range of concern for ambient hydrogen sulfide concentrations of 0.03 mg/cu m to 14.0 mg/cu m. This corresponds to motor vehicle emission levels of from 10.5-4,900 mg/mile to 958.5-447,300 mg/mile on the road and 0.04-204 mg/min to 3.8-1,770 mg/min for garages, depending on the type of scenario chosen to represent public exposure. Under non-malfunction conditions or when the malfunction does not cause a rich mixture, high catalyst temperature and low exhaust space velocity, the resulting H2S emissions are negligible (below the range of concern for any scenario).

61998 **(PB—82-206368) A thermal desorption cold-trap unit for gaschromatographic analysis of gaseous organic pollutants.** Karlsson, V.; Schulting, F. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Kemian Lab.). 1982. 31p. NTIS, PC A03/MF A01.

In atmospheric sampling, a preconcentration step is often necessary to raise the concentration of the pollutants above the sensitivity level of the detecting apparatus. During the work period at IMG-TNO, a thermal desorption cold-trap (TCT) unit was fitted up. The TCT unit was built (by Frans Schulting) for preparation of concentrated samples on solid sorbent material for further analysis. The optimum settings for efficient desorption as well as for cooling and heating of the cold-trap were tested. The desorption efficiency of the instrument was at least 95%. No cold spots or dead points were observed where the sample compounds could condense and remain. The TCT unit caused neither peak broadening or separation problems. The developed technique was applied to ambient air and automobile exhaust analysis. (Copyright (c) Valtion teknillinen tutkimuskeskus (VTT) 1981.)

61999 **(UCRL—87553) Simple model of stratified precipitation for scavenging studies.** Molenkamp, C.R. (Lawrence Livermore National Lab., CA (USA)). Aug 1982. Contract W-7405-ENG-48. 4p. (CONF-821114—1). NTIS, PC A02/MF A01. Order Number DE82020378.

From American Meteorological Society conference on cloud physics; Chicago, IL, USA (15 Nov 1982).

2BPUFF (Crawford, 1966) is a 2-D, axisymmetric Lagrangian model used for calculating scale-dependent diffusion in a frame of reference moving with the center of the cloud of released material. ADPIC (Lange, 1978) is a 3-D particle-in-cell diffusion model which uses measured winds interpolated mass-consistently to calculate trajectories. Both of these models have been very successful in calculating pollutant concentrations up to several days downwind when compared with measured concentrations. These long-range transport and diffusion models currently have crude capabilities to include precipitation scavenging based on input information on rain location and rate. The goal is to develop techniques for specifying the scavenging rate used in these models in a manner that considers more of the physical variations in the atmosphere and yet is consistent in complexity with the assumptions used in the transport and diffusion models.

62000 **Determination of atmospheric nitrate and nitric acid employing a diffusion denuder with a filter pack.** Forrest, J.; Spandau, D.J.; Tanner, R.L.; Newman, L. (Brookhaven National Lab., Upton, NY). *Atmospheric Environment;* **16**: No. 6, 1473-1485(1982).

A diffusion denuder assembly for sampling and analyzing atmospheric gaseous and particulate nitrate without significant artifactual error was construced and evaluated. The system consists of parallel filter packs, one to determine total inorganic nitrate and the other, preceded by a diffusion denuder to remove nitric acid, to measure particulate nitrate. Nitric acid is determined by difference. Ambient sampling data for total nitrate (sum of nitric acid and particulate nitrate) were statistically identical by either high volume or low volume sequential filter packs. Differences between nitric acid and nitrate data by filter pack and diffusion denuder methods were attributed principally to known sources of error in the former-adsorption of HNO_3 on collected particles and evaporation of nitric acid from collected ammonium nitrate particles. Negative correlation of particulate nitrate and strong acid levels was observed. During long sampling times adsorption of HNO_3 on collected particles is apparently the dominant source of error eliminated by use of the diffusion denuder method; for short sampling ties, evaporative loss of NH_4NO_3 is dominant. Losses of nitrate particles by impaction or ammonium nitrate by evaporation in the denuder appear to be negligibly small for particles $\leqq 3$ μm.

62001 **Oxidation of SO_2 in droplets which contain soot particles.** Brenner, W.H.; Brodzinsky, R.; Novakov, T. (Lawrence Berkeley Lab., CA). *Atmospheric Environment;* **16**: No. 6, 1333-1339(1982).

A laboratory fog chamber was constructed in which water droplets or droplets containing soot particles could be exposed to SO_2. For wet particles exposed to 0.007 ppm $<[SO_2]<$222 ppm, the maximum experimentally observed carbon-normalized rate of particulate sulfate formation was $d[SO^{2}{}_{4}{}^{-}/C]/dt = 8 \times 10^{-6}$ (g $SO^{2}{}_{4}{}^{-}$) (g C^{-1})s^{-1}. The rate expression, $-d[S(IV)]/dt = k[C].(\alpha[S(IV)]^2/1 + \beta[S(IV)] + \alpha[S(IV)]^2)$, was determined for the reaction. Under atmospheric conditions, this rate expression indicates that the effective order for the oxidation of S(IV) depends on environmental conditions and ranges between 0.1 and 1.6.

62002 **Parametric study of the effects of arctic soot on solar radiation.** Porch, W.M.; MacCracken, M.C. (Lawrence Livermore Lab., CA). *Atmospheric Environment;* **16**: No. 6, 1365-1372(1982).

A numerical radiative transfer model has been used to simulate the possible effects of carbonaceous aerosol on the Arctic climate. Because of uncertainties in aerosol properties in the Arctic, the sensitivity of modeled components of the solar radiation budget to ranges in aerosol parameters was determined. It was found that differences in assumed aerosol absorption, concentration and vertical distribution were more important than differences in aerosol size distribution. Aerosol absorption was parameterized through the index of refraction assuming an aerosol composed of soot and sulfates. Modeling the radiative effects of the springtime phenomena of Arctic soot leads to an increase in average heating rates of 0.01-0.06 K day^{-1} in the lowest 1-5 km of the atmosphere under cloud free conditions. The higher value is similar to estimated heating rates at northern latitudes that would result from doubling atmospheric CO_2 concentrations. The hemispheric average temperature change due to the Arctic soot is, however, estimated to be almost two orders of magnitude less than for doubling of CO_2 concentrations.

62003 **Long-range plume dispersion: comparisons of the Mt. Isa data with theoretical and empirical formulas.** Gifford, F.A. *Atmospheric Environment;* **16**: No. 6, 1583-1586(1982).

Recent measurements of widths of the plume from the Mt. Isa ore smelter, extending to 1000 km downwind, are compared with empirical and theoretical formulas for the horizontal diffusion length, $\sigma y \propto$ t/sup 1.2/; and a recently developed theoretical curve by Gifford (1980). Correlations are high ($r \sim 0.9$) in all cases, but slightly higher for the theoretical curve. This indicates that its more complex shape indeed corresponds better to these data.

62004 **Storage and release of organic carbon in peninsular Malaysia.** Chan, Y.H. (Oak Ridge National Lab., TN). *International Journal of Environmental Studies;* **18**: No. 3-4, 211-222(1982).

The tropical forest is an important component in the study of possible climatic changes resulting from increasing levels of atmospheric CO_2. A methodology has been developed to estimate total carbon from commercial timber volume and regional soil sample analyses. This paper develops and tests an approach to estimate carbon storage and release in tropical forests from available national surveys and inventories of forest resources. As a specific case study, the approach is applied to Peninsular Malaysia where biomass production of tropical rain forest was also studied under the Malaysian International Biological Program (IBP) project. (JMT)

62005 **Compilation of an inventory of anthropogenic emissions in the United States and Canada.** Benkovitz, C.M. (Brookhaven National Lab., Upton, NY). *Atmospheric Environment;* **16**: No. 6, 1551-1563(1982).

The quantification of anthropogenic emissions of pollutants is a key task of the Multistate Atmosphere Power Production Pollution Study (MAP3S). The emissions inventory project has been based on obtaining pertinent data gathered by other agencies. This article describes the data obtained and the methodologies developed to organize, merge and manipulate these data so as to provide input and answers to researchers participating in MAP3S. Summaries derived from the data currently available are included to present an overview of the current status of anthropogenic emissions in the United States and Canada.

62006 **Sulfate aerosol production in coal-fired power plant plumes.** Liebsch, E.J.; de Pena, R.G. (Pennsylvania State Univ., University Park). *Atmospheric Environment;* **16**: No. 6, 1323-1331(1982).

As part of the Winter Study of Power Plant Effects (WISPE), air chemistry measurements were made in the plumes of the coal-burning Bowen Electric Generating Plant in northwest Georgia. Ten flights were made using the instrumented Pennsylvania State University research aircraft. Measurements included condensation nuclei concentration, aerosol size distribution and sulfur dioxide concentration. Quantitative chemical analysis of impactor-collected sulfate particles, together with these measurements, allowed for calculation of SO_2-sulfate conversion rates. In addition, nuclei concentrations were analyzed as a function of plume age and position in the plume. SO_2 conversion rates and nuclei production were examined for dependence on various meteorological parameters in order to better understand the mechanisms of sulfate aerosol production. A comparison was made with the findings of a similar study conducted at the Keystone Power Plant in southwestern Pennsylvania. The conversion rates of SO_2 to SO^{2-}_4 were under 0.2% h^{-1} with the exception of one flight for which a rate of 2.3% h^{-1} was calculated. Nuclei production was found to be dependent on both solar flux and plume dilution. Evidence of enhanced nuclei production at plume borders was also found. This implies that entrainment of photochemically produced species from the surrounding air mass is responsible for gas-phase oxidation which results in nuclei production.

62007 **Dual flexible-brush dust-feed mechanism.** Milliman, E.M. (Battelle Pacific Northwest Lab., Richland, WA); Chang, D.P.Y.; Moss, O.R. *American Industrial Hygiene Association Journal;* **42**: 747-751(Oct 1981). Contract AC06-76RL01830.

A novel design for the feeding of bulk powders at the low rates suitable for exposure chamber studies is described. The feed mechanism consists of two rotating brushes, the larger of which supplies dust from a hopper to a second, spirally wound feed brush. The dust is conveyed through a tube to an aerosol dispersion device. The dual-brush dust-feed mechanism exhibits a coefficient of variation of 7.2% and 2.0%, based upon 5-minute averages of a western fly ash sample at feed rates of 6.23 mg/min and 21.1 mg/min, respectively. Feed rate was linearly related to the rotational speed of the feed-brush over the range examined. Principal advantages of the dust-feed mechanism are: excellent stability over periods approaching 24 hr; low construction cost; simplicity of design; ability to handle powders which are difficult to compact into a dust cake; wide operational limits on feed rates. The device is not a positive displacement feeder, so that a calibration curve of mass output rate versus brush rotational speed must be developed for each type of dust dispensed.

62008 **Continuous determination of gaseous ammonia in the ambient atmosphere using fluorescence derivatization.** Abbas, R.; Tanner, R.L. (Brookhaven National Lab., Upton, NY). *Atmospheric Environment;* **15**: 277-281(1981).

A method for continuous determination of ambient ammonia levels emploting o-phthalaldehyde fluorescence derivatization is described. A simplified Venturi scrubber and gas-liquid separator have been employed for reproducible measurements of greater than or equal to 0.1 ppb ambient ammonia with less than 2 min time resolution. The scrubbing efficiency of the ammonia gas collection system was determined to be 29 +/- 1%. During 4 d in August 1979 ambient ammonia levels at the Brookhaven National Laboratory site averaged about 1.5 +/- 1.1 ppb during afternoon daylight hours.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 61016, 61675, 61989, 62021, 62022, 62117

62009 **(DOE/EML—407) Radon and radon daughter measurements in solar energy-conservation buildings.** George, A.C.; Knutson, E.O.; Franklin, H. (Department of Energy, New York (USA). Environmental Measurements Lab.). Jul 1982. 16p. NTIS, PC A02/MF A01. Order Number DE82021874.

Measurements of radon and radon daughters in 11 buildings in five states, using active or passive solar heating showed no significant increase in concentration over the levels measured in buildings with conventional heating systems. Radon levels in two buildings using rock storage in their active solar systems exceeded the US Nuclear Regulatory Commission's 10 CFR 20 limit of 3 pCi/l for continuous exposure. In the remainder of the buildings, radon concentrations were found to be at levels considered to be normal. It appears that the slightly elevated indoor radon concentrations result from the local geological formations and from the tightening of the buildings rather than as a result of the solar heating technology.

62010 **(NP—2906001) Fort St. Vrain Nuclear-Generating Station Environmental Radiation Surveillance Program. Summary report, first and second quarters, 1982.** Johnson, J.E. (Colorado State Univ., Fort Collins (USA)). 1982. 130p. NTIS, PC A07/MF A01. Order Number DE82906001.

Environmental Radiation Surveillance data for the Fort St. Vrain nuclear power plant for the first and second quarters of 1982 are summarized. (ACR)

62011 **(NUREG/CR—1895) Investigation of the degree of equilibrium of the long-lived uranium-238 decay-chain members in airborne and bulk uranium-ore dusts.** Jackson, P.O.; Thomas, C.W. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1982. Contract AC06-76RL01830. 55p. (PNL—3696). GPO $4.75.

The degree of disequilibrium among ^{238}U decay chain members in some airborne dusts and typical ores has been established by precise radiochemical analyses. This information is necessary to evaluate the lung dose model currently used for estimating the effect of the inhalation of uranium ore dust. The particle size distributions of airborne decay chain components in dusts at one uranium mill have been investigated. Statistically significant disequilibria were observed for ^{230}Th, ^{226}Ra, and ^{210}Pb in both airborne dusts and composite ore samples. With the exception of ore from one mill in the United States, most of the daughter concentrations in powdered ore composites were within 10% of ^{238}U. In airborne dusts, the concentration of ^{226}Ra was typically below ^{238}U; the minimum ^{226}Ra concentration observed for airborne ore dusts was 56% of equilibrium. A statistically significant particle size depend-

ence was observed for $^{226}Ra/^{238}U$ ratios in several airborne dusts collected at a uranium mill.

62012 **(NUREG/CR—2438) Wet-deposition processes for radioiodines.** Keller, J.H.; Hoffman, L.G.; Voilleque, P.G. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA); Science Applications, Inc., Idaho Falls, ID (USA)). Aug 1982. Contract AC07-76ID01570. 66p. (ENICO—1111). NTIS, PC A04/MF A01 - GPO.

The results of a review of wet deposition processes for radioiodines are presented. Experimental measurements have shown that precipitation scavenging can be an important process for removal of radioiodines released to the atmosphere. Measurements of radioiodine species in routine gaseous effluents have shown that the distribution depends upon the type of nuclear facility considered. Because of differences in radioiodine species, observed scavenging rates for radioiodine in fallout are not generally applicable to routine releases from nuclear facilities. Adequate models are available to estimate the air to surface transport by wet processes. At the present time, the need is for more information on the rate constants used in the models. Reactor accident consequence calculations that assume no behavior differences among iodine species indicate that about half the predicted early deaths and illnesses are attributable to radioiodines. The distribution of species released under accident conditions will depend upon the actual sequence of events. However, for many scenarios the wet deposition of radioiodines will have an important bearing on the consequences.

62013 **Applicability of gaussian plume dispersion parameters to acute radionuclide releases.** Miller, C.W.; Fields, D.E. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **35**: 49-50(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

5006 Regulations

REFER ALSO TO CITATION(S) 61597, 61617, 61618, 61619, 61650, 61651, 61652, 61653, 61906, 61907

62014 (CONF-8110215—, pp 150-154) **Acid rain: its impacts on public health and the environment.** Robinson, R.M. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

International cooperative efforts between US and Canada are reviewed. A continued program is urged in order to minimize both social and environmental impacts. (PSB)

62015 **(PB—82-202581) Fossil fuel fired industrial boilers - background information. Volume 2: appendices. Draft report.** (Environmental Protection Agency, Atlanta, GA (USA). Region IV). Mar 1982. 331p. NTIS, PC A15/MF A01.

The purpose of this study was to develop background information to support New Source Performance Standards (NSPS) for industrial boilers. Work on this study was performed by the Acurex Corporation from June 1978 until February 1980 and by the Radian Corporation after February 1980 under contract with the United States Environmental Protection Agency, Office of Air Quality Planning and Standards. The following chronology lists the major events which have occurred during the development of background information for the industrial boiler NSPS. Major events are divided into three categories: (1) plant visits and emission testing, (2) meetings and briefings, and (3) reports and mailings.

51 ENVIRONMENTAL SCIENCES,

TERRESTRIAL

5101 Basic Studies

62016 **(CONF-8108137—1) Analyses of ecoregions utilizing the geoecology data base.** Olson, R.J.; Kumar, K.D.; Burgess, R.L. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01. Order Number DE82020903.

From National workshop on in-place resource inventories: principles and practices; Orono, ME, USA (9 Aug 1981).

Portions of document are illegible.

Ecoregions exhibit a high degree of separability which is demonstrated statistically using discriminant analysis and county-level data representing ecoregion classification criteria. Ecoregions provide a useful, integrated, hierarchical framework for conducting regional assessments of environmental impacts by stratifying the country into homogeneous environmental units. Studies comparing potential wilderness areas and assessing acid rain impacts illustrate application of ecoregions.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 60899, 60900, 60901, 60902, 60903, 60909, 60910, 60911, 61989, 62004, 62016, 62020, 62054

62017 **(DOE/EV/10687—2) Accurate determination of $^{13}C/^{12}C$ in CO_2 of past atmospheres from $^{13}C/^{12}C$ in tree rings by removal of climatic interferences. Final technical progress report.** Long, A.; Leavitt, S.W. (Arizona Univ., Tucson (USA)). Jul 1982. Contract AC02-81EV10687. 6p. NTIS, PC A02/MF A01. Order Number DE82021975.

Analysis of $\delta^{13}C$ in tree rings offers the potential for reconstructing changes in $\delta^{13}C$ of atmospheric CO_2, which combined with ^{14}C trends will be important in evaluating the past and present role of the biosphere as a net carbon dioxide source or sink. One problem with such tree-ring $\delta^{13}C$ records is that in addition to changes in atmospheric $\delta^{13}C$, climatic factors may influence the isotopic composition of the rings. This study examines $\delta^{13}C$ in cellulose of five-year intervals of juniper tree rings. The sampling sites were near weather stations for which climate data are readily available. $\delta^{13}C$ vs winter climate relationships were derived from those sites not under the influence of local pollution sources. These relationships facilitated development of a $\delta^{13}C$ record from which climate effects have been factored out. The resulting 1930-1979 $\delta^{13}C$ reconstruction shows a pronounced $\delta^{13}C$ decrease from 1930 to 1960 and then a post-1960 flattening of the curve. We interpret this trend as representing an increasing role of biospheric CO_2 sinks relative to sources, although other interpretations may be possible within the limits of precision of data analysis. Research with this technique is continuing with pinyon pine and dendroclimatological reconstructions to verify these results and to develop a climate-free $\delta^{13}C$ chronology back to pre-industrial time.

62018 **(EPRI-CS—2513) Amine-enhanced photodegradation of polychlorinated biphenyls. Final report.** Meuser, J.M.; Weimer, W.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1982. Contract AC06-76RL01830. 57p. NTIS, PC A04/MF A01. Order Number DE82021378.

Uncontrolled releases of polychlorinated biphenyls (PCBs) from transformers and capacitors pose a significant environmental problem to the electric utility industry. This report describes a series of experiments whose objective was to demonstrate the practicality of using natural solar radiation in conjunction with the application of an amine for in situ degradation of PCBs in contaminated soil. The soil tested was clay from beneath a capacitor rack at a pacific northwest utility substation. While no degradation of the PCBs in soil was found after two weeks of sunlight exposure, further solution experiments indicate that degradation of PCBs does occur in the presence of an amine and simulated solar radiation. In hexane solutions containing 1 ppM Aroclor 1268 with 10 and 100 ppM ethylenediamine, 37% and 53% reductions in PCB concentration, respectively, were found after 70 h of solar simulator irradiation. These results suggest that the clay matrix or other soil compo-

nents may have interfered with the photodegradation process. Investigations into the reaction mechanism, reaction products, optimum treatment parameters and appropriate matrices appear to be warranted. Successful development of this in situ technique could lead to major savings in mitigation efforts for contaminated soils and surfaces.

62019 **Chemistry of atmospheric precipitation in the north-central United States: influence of sulfate, nitrate, ammonia and calcareous soil particulates.** Munger, J.W. (Univ. of Minnesota, Minneapolis). *Atmospheric Environment;* 16: No. 7, 1633-1645(1982). Contract AC02-77EV04327.

Major ions and trace metals were determined in precipitation-event and snow-core samples from sites along a 600 km transect from the North Dakota prairie to the forests of northeastern Minnesota, collected during the period April 1978-June 1979. Acidity increased 4-fold from west to east as the effect of alkaline dust and NH_3 decreased with increasing distance from the cultivated prairie; calcium and Mg^{2+} decreased 2 to 3-fold across the transect. Winter snow cover and freezing temperatures, which decreased airborne soil dust and the evolution of NH_3 from the prairie soils, led to an increase in precipitation acidity at all sites. Winter inputs of acid are especially important because they are released during a short period in the spring. Precipitation inputs of P and N probably benefit nutrient-poor ecosystems in the north-central United States. However, acid precipitation at Hovland is approaching levels known to cause adverse effects in sensitive regions. The geology of northeastern Minnesota, adjoining Ontario, and northern Wisconsin is similar to that in areas where lake acidification and losses of fish populations have occurred, so that such problems may eventually occur in central North America. (JMT)

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 60895, 61013, 61014, 61989, 62010, 62043

62020 **(DOE/DP/04515—2) Redox reactions involving chromium, plutonium, and manganese in soils. Final report, 1 July 1978-30 September 1981.** Amacher, M.C.; Baker, D.E. (Pennsylvania State Univ., University Park (USA). Inst. for Research on Land and Water Resources). Jun 1982. Contract AS08-77DP04515. 178p. NTIS, PC A09/MF A01. Order Number DE82021130.

Thesis.

Although particulate movement through wind and water erosion is the most important mechanism of dispersion of Pu at the Nevada Test Site, dispersion of water-soluble species may also be occurring. However, because Pu is toxic, usually insoluble, not uniformly distributed in the soil, and can exist in four oxidation states in the environment, it is very difficult to study. Therefore, Cr reactions in soil were investigated as a possible general model for Pu reactions in soil, since it was postulated that the redox chemistries of the two elements should be similar. Chemical fractionation methods were used to determine the redox states of Pu in a Nevada Test Site soil and the amounts of Pu associated with various soil components in order to deduce possible reactions between the various Pu species and soil components so that weathering and dispersion by chemical mechanisms can be predicted. Chemical fractionation and kinetics experiments were performed to study reactions of Cr with soil, manganese oxides, and fulvic acids in order to provide information to eventually develop a qualitative, predictive model for Pu behavior in soil.

62021 **(ISH—7) Survey of gamma radiation in the vicinity of the Asse Saltmine radioactive-waste-disposal site.** Gogolak, C.V.; Endrulat, H.J. (Institut fuer Strahlenhygiene des Bundesundheitsamtes, Muenchen (Germany, F.R.)). Sep 1981. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82906234.

A survey of the gamma radiation environment near the Asse Salt Mine Radioactive Waste Disposal Site was made using a Ge(Li)-spectrometer calibrated for in-situ measurements and an organic scintillation dose rate meter type PTB 2701. Results are reported for ten measurement sites. The Ge(Li) gamma ray spectra taken at each site were recorded on a magnetic tape cassette for analysis. Each spectrum was carefully examined for the presence of gamma-ray lines from artificial radionuclides. In each case, only ^{137}Cs from atmospheric nuclear weapons test fallout was found. For each measurement site, the natural background radioactivity from ^{40}K, ^{238}U, and ^{232}Th was determined. For ^{238}U and ^{232}Th, four separate gamma-ray lines in each decay series were analyzed (352, 609, 1120, and 1765 KeV for ^{238}U and 583, 911, and 2615 KeV for ^{232}Th) and then averaged in determining both the radionuclide concentration in the soil, and the resulting exposure rate at one meter above the ground. Radioactive equilibrium among the radionuclides of each series was assumed. The exposure rate due to the ^{137}Cs present was estimated from the 662 KeV gamma-ray line. The exposure rate contribution from the short-lived daughters of ^{222}Rn in the air near the ground was estimated to add 10% to the exposure rate due to ^{238}U and its daughters in the soil. Measurements of the total exposure rate due to gamma-ray sources in the soil and cosmic radiation were also measured.

62022 **(PNL—3858) Evaluation of radon progeny from Mount St. Helens eruptions. Final report.** Lepel, E.A.; Olsen, K.B.; Thomas, V.W.; Eichner, F.N. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1982. Contract AC06-76RL01830. 36p. NTIS, PC A03/MF A01. Order Number DE82022518.

A network of twelve monitoring sites around Mount St. Helens was established to evaluate possible short-lived radioactivity in the fallen ash. Seven sites were located near major population centers of Washington and Oregon, and five sites were located within 80 km of the volcano. Each site monitored the radioactivity present by the use of thermoluminescent dosimeters which recorded the total exposure to radioactivity over the exposure period. Eruptions occurring on July 22, August 7, and October 16 to 18, 1980 were monitored. No statistically significant quantities of measurable radon daughters were observed.

62023 **(SCPRI-RT—3-1981) Activity report of the French Central Service for Protection against Ionizing Radiation.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). 1981. 31p. (In French). Dep. NTIS, PC A. Order Number DE82903176.

Portions of document are illegible.

Tabulated data are presented on the average level of radioactive ionization activity in and around various nuclear sites in France. Information is also given on measures to be taken following radiation accidents. Tables cover data reported for the months of July, August, and September 1981. 40 references.

62024 **(SCPRI-RT—4-1981) Activity report of the French Central Service for Protection against Ionizing Radiation.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). 1981. 32p. (In French). Dep. NTIS, PC A. Order Number DE82903185.

Portions of document are illegible.

Tabulated data are presented on the average level of ionizing radiation detected at various nuclear sites (primarily from Be, Sr, Zr, and Nb isotopes) in both inland and coastal areas of France during the months of October, November, and December 1981. 40 references.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 60796, 60800, 60996, 62054

5106 Regulations

REFER ALSO TO CITATION(S) 61650, 61651, 61652, 61653

62025 **(NP—2906069) Report to the Missouri General Assembly on hazardous waste management in Missouri.** (Missouri Dept. of Natural Resources, Jefferson City (USA). Hazardous Waste Management Task Force). Sep 1981. 39p. NTIS, PC A03/MF A01. Order Number DE82906069.

Results of a study conducted by the Hazardous Waste Management Task Force are presented. The current hazardous waste situation in Missouri is reviewed. The task force identified 5 major

issues and developed 11 recommendations. Issues identified are: development of alternatives to hazardous waste landfills; operation of hazardous waste exchange; Missouri Hazardous Waste Law; Missouri Hazardous Waste Regulations; and funding for hazardous waste programs.

62026 **(USGS-OFR—81-1249) Permit requirements for development of energy and other selected natural resources for the State of Alaska.** (Geological Survey, Washington, DC (USA)). Aug 1981. 102p. Geological Survey, Open File Service, Denver Federal Center, Box 25425, Denver, CO 80225.

This guidebook summarizes environmental and land-use permits issued by the State for the development of energy and other natural resources. The guidebook is intended not only for private developers and interest groups, but also for regulatory officials of Federal, State, and local government as well. The guidebook is divided into seven sections: Introductory Information; Consolidated Permit Programs, Local Regulatory Policies; Resource Extraction; Land Use Regulation; Environmental Quality Management; and Social/Ecological Preservation. Each section is divided into chapters; each chapter summarizes one permit, license, or approval. Permits administered by a single agency are generally grouped together in each section. (PSB)

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 60860, 61120, 61975, 62544, 62545

62027 (CONF-8106214—, pp 301-342) **Possibilities of detecting CO_2-induced effects: ocean physics.** Baker, D.J. Jr. (Univ. of Washington, Seattle); Barnett, T.P. 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

The general theme of this study is to examine the possible effects of an increased atmospheric concentration of CO_2 and to propose ways to detect the first environmental effects of such an increase; this report focuses specifically on the physics of the ocean. What is known about the ocean circulation and mixing system and the tools available for improving that understanding are considered. The heart of the report is a speculative discussion of the sensitivity of physical oceanographic parameters to the effects of increasing CO_2. A general detection strategy for identifying possible CO_2 effects is suggested, and crude estimates of the resources necessary to carry out the strategy are given. Of the physical parameters that describe the ocean, sea level observations appear to offer the best opportunities for early detection of CO_2-induced effects. Changes of key wind-driven current systems in response to subtle changes in global wind-stress patterns offer an equally attractive possibility for early detection. Direct changes of ocean temperature and salinity that would accompany a CO_2 increase will probably be difficult to observe.

62028 (CONF-8106214—, pp 361-384) **Carbon dioxide and ocean chemistry.** Brewer, P.G. (Woods Hole Oceanographic Inst., MA). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

The problems of detecting the first effects of CO_2-induced climate change from the perspective of a marine geochemist are examined. The fundamental behavior of CO_2 in sea water is reviewed, and current evidence for penetration of fossil fuel CO_2 into the oceans is examined. This is now possible both from direct observations and from examination of the behavior of tracer analogs of CO_2. The accurate interpretation of data is a necessary step in the detection of climate change. It is printed out that while documenting CO_2 changes in the ocean is important in its own right, it is the correlation of these changes with temperature that is of greatest interest for climate change. (JGB)

62029 (CONF-8106214—, pp 503-531) **Effects of increased atmospheric CO_2 concentration on marine productivity.** McCarthy, J.J. (Harvard Univ., Cambridge, MA). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

There are many indications that a doubling in atmospheric CO_2 concentration will affect patterns in marine primary productivity. However, it is unlikely that the anticipated increase in the CO_2 content of sea water per se will have dramatic effects. The possible consequences of reduced sea water pH are difficult to assess at this time. The expected warming of the ocean would alter distribution patterns of some species of phytoplankton and macrophytes, but it is not evident that the resultant global marine productivity would be any different from today. Many species of vertebrates and invertebrates that play important roles in the ecosystems of certain locales have well-defined limits of temperature tolerance. This is particularly well documented for species of commercial importance. Continued warming of the sea surface could result in altered habitat ranges and perhaps extinction for some of these species. Extrapolations from paleo-oceanographic data suggest that ocean circulation could change considerably with a few degrees' increase in mean global sea-surface temperature. The intensity of upwelling along eastern boundary currents is apparently much reduced today relative to 18,000 years BP. A continuation of this trend would result in less productivity in these regions, the most obvious effect of which would be a reduced harvest of many species that are of great commercial interest to man. In addition, there could be long-term consequences for the global nitrogen cycle if reduced productivity in upwelling regions were to lead to markedly reduced rates of denitrification. The uncertainty in current estimates regarding the rate of productivity in marine systems, particularly the oceanic regions, makes the biota of the oceans an unlikely target for the detection of early effects of a global CO_2 problem.

62030 **(DOE/EV/01599—219-Pt.1) Dissolved organic matter and lake metabolism: biogeochemistry and controls of nutrient flux dynamics in lakes. Technical progress report, 1 August 1981-25 August 1982.** Wetzel, R.G. (Michigan State Univ., Hickory Corners (USA). W.K. Kellogg Biological Station). 1982. Contract AC02-76EV01599. 49p. (COO—1599-219-Pt.1). NTIS, PC A03/MF A01. Order Number DE82021861.

From initial analyses of critical components of representative freshwater systems, the research has expanded to a major integrated program on the regulatory mechanisms of growth and rates of carbon cycling that focuses on detailed evaluation of quantitative control interactions among (1) the microflora of the pelagial zones of several lakes of progressively greater eutrophy, (2) littoral and wetland photosynthetic producer-decomposer complex, and (3) allochthonous inorganic-organic influxes and their biotic processing. The underlying thesis is that quantification of the dynamic carbon fluxes among these components and their rate control mechanisms by physical and chemical factors are fundamental to elucidation of the rate functions of lake productivity and compensatory mechanisms in response to changes. A major portion of the present research and that of the past contract year has been directed towards the fate and nutrient mechanisms regulating qualitative and quantitative utilization and losses of organic carbon synthesized within lakes and their drainage basins. It has become increasingly apparent that the wetland and littoral flora, and attendant epiphytic and benthic microflora, have major regulatory controls on biogeochemical cycling of whole lake systems. A major effort on factors regulating the metabolism of littoral and wetland macrophytes and attached algae has been coupled to integrated studies on their decomposition and the fate of detrital dissolved and particulate organic matter. These organic products are being coupled to influences on enzymatic activity and inorganic nutrient cycling, and resultant effects on phytoplankton community and productivity.

62031 **(DOE/EV/01599—219-Pt.4) Pattern and process of clonal growth in a common cattail (Typha latifolia L.) population.** Dickerman, J.A. (Michigan State Univ., East Lansing (USA)). 1982. Contract AC02-76EV01599. 109p. (COO—1599-219-Pt.4). NTIS, PC A06/MF A01. Order Number DE82021971.

Thesis.

A detailed analysis of individually identified Typha latifolia shoots quantified the births, deaths, life histories and productivities of the shoots. Three levels of plant structure were addressed: Inter-shoot relationships, individual shoot behavior and leaf dynamics. Shoots emerged in three major emergence pulses each year, and were grouped by these pulses into three major cohorts. The first cohort emerged in early spring, grew throughout the growing season, and died in late autumn. The second cohort emerged in midsummer; 70 to 80 percent of these shoots died in autumn, while the remainder resumed growth in the following spring. The third cohort emerged in late summer and early autumn; 80 to 90 percent of all third cohort shoots resumed growth the following spring. An intrinsic or self-regulation of density through reallocation of assimilates between shoots and rhizomes adequately explained the density patterns. This regulation is based on the growth pattern and the differing roles of the cohorts: The first and third cohorts are predominately regenerative, while the second cohort is proliferative, and fills in shoot density if, in early spring, density is below a shoot saturation level that apparently effectively holds marsh space.

62032 **(DOE/EV/10259—T2) Geographic analysis of thermal equilibria: a bioenergetic model for predicting thermal response of aquatic-insect communities. Technical progress report, January 1, 1981-December 31, 1982.** Vannote, R.L.; Sweeney, B.W. (Academy of Natural Sciences, Avondale, PA (USA). Stroud Water Research Center). 27 Aug 1982. Contract AC02-79EV10259. 163p. NTIS, PC A08/MF A01. Order Number DE82020942.

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The principal objective is to test and refine a proposed conceptual model (Vannote and Sweeney, 1980) describing the effects of natural and altered temperature regimes on larval growth and adult size and fecundity of hemimetabolous aquatic insects. The central hypothesis is that the stability of a given population within the geographic range of a species reflects mainly a dynamic equilibrium between temperature and individual growth, metabolism, reproductive potential, and generation time. The model predicts that geographic range extension away from a location with an optimum thermal regime would be associated with temperature induced changes in the rate and efficiency of energy use, developmental processes, and generation time. This progress report summarizes results of field and laboratory experiments during the first three sampling years, describes work still in progress, and outlines proposed research for the fourth sampling year.

62033 **Interaction of salinity, predators, light, and copepod color.** Hairston, N.G. Jr. (Univ. of Rhode Island, Kingston). *Hydrobiologia;* **81**: 151-158(1981).

Color differences are examined in populations of Diaptomus navadensis found in two athalassic salt lakes of the Lower Grand Coulee, Washington. Data show that the distribution of red copepods is limited by predators and predator species is determined by salinity of the lakes. Where predators use vision to detect their prey, the color of D. nevadensis is diminished. The carotenoid probably serves to protect the animals from damage by visible light. (JMT)

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 60860, 60862, 60863, 60864, 60880, 60892, 60894, 60897, 60904, 60905, 60907, 60908, 61675, 61989, 62042, 62044, 62047, 62054, 62164, 62165, 62167, 62185, 62187

62034 **(CONF-8108135—1) Modeling the distribution of chemicals in aquatic environments.** Yeh, G.T. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01. Order Number DE82020937.

From IPA workshop on modeling the fate of chemicals in the aquatic environment; Pellston, MI, USA (17 Aug 1981).

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Assessing the potential hazard and/or risk resulting from chemical perturbation to the aquatic environment is a highly complex problem. It requires prior knowledge of the spatial-temporal distribution of chemicals among various carriers including water, sediment, and biota. The simultaneous presence of numerous interactive processes - physical and chemical as well as biological - makes it difficult to predict in advance the possible spatial-temporal distribution of chemicals in a given environment. Models, admittedly deficient and limited, provide a powerful tool for forecasting the response of the aquatic environment to the chemical perturbation, particularly when many variables must be considered. This paper discusses modeling approaches in perspective. Emphasis is put on models derived from physical, chemical, and biological principles and on the need for continuing model development and improvement. Because the availability of data and the level of detail desired vary from case to case, hierarchical approaches are required, necessitating the application of models with different levels of resolution.

62035 **(EPRI-CS—2498) Monitoring the fixed FGD Sludge Landfill, Conesville, Ohio. Phase II. Second interim.** Hupe, D.W. (Baker (Michael), Jr., Inc., Beaver, PA (USA)). Jul 1982. 101p. NTIS, PC A06/MF A01. Order Number DE82905827.

This report summarizes the Phase II, Second Interim activities for ongoing investigations for fixation/stabilization of flue gas desulfurization sludge (the Poz-O-Tec system). The investigations are being conducted at the Conesville Power Station of Columbus and Southern Ohio Electric Company where the CSI system was first applied on a fullscale basis and Poz-O-Tec has been landfilled since January 1977. The report presents an up-date on Phase II activities which include (1) groundwater and runoff sampling conducted on a quarterly basis to monitor for related contamination; (2) annual sampling and testing of Poz-O-Tec samples from the landfill for comparison with CSI projected physical characteristics; (3) observation of disposal operations in order to identify any problems associated with utilization of the system; and (4) assessment of overall environmental acceptability. The report also summarizes Phase I and Phase II, First Interim work. This project will supply the utility industry with an unbiased evaluation of the benefits and drawbacks of the CSI systems as seen at the Conesville Station under full-scale operations.

62036 **(EPRI-CS—2558) Stochastic-convective ensemble method for representing dispersive transport in groundwater.** Simmons, C.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1982. Contract AC06-76RL01830. 111p. NTIS, PC A06/MF A01. Order Number DE82021340.

A stochastic-convective transport method is developed to describe three-dimensional hydrodispersion of a non-reactive solute in groundwater. The method is based on the probability density function (Pdf) for an ensemble model of stochastic variation in flow velocity. It is shown how the statistical parameters of a travel length Pdf are related to the mean and spatial covariance of a velocity field. Concepts of the method are demonstrated explicitly with a simple example tent-shaped Pdf. Linear increase of effective dispersivity with solute travel distance, when velocity correlation is long-range, is explained by the method. Previously derived results about macrodispersion in a stratified system (Materon and DeMarsily 1980) are obtained with an ensemble viewpoint and are generalized for non-uniform velocity. A scale-relation description of hydraulic conductivity and hydraulic gradient random variations is developed to represent stochastic velocity. That approach is based on a multiplicative rather than an additive stochastic process. It is shown that a covariance function for relative velocity variation, i.e., a ratio of random velocity to the mean, is perhaps a better description of random variations in porous media. The method is applied to a small-scale tracer experiment performed near the Borden landfill, Waterloo, Ontario. An indirect evaluation of stochastic transport parameters is demonstrated for the sandy aquifer site.

62037 **(K—2031) Environmental water analysis by ion chromatography.** Merriweather, R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Aug 1982. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01. Order Number DE82021533.

This project was initiated to evaluate ion chromatography (IC) as a substitute method of analysis of environmental water samples for the following ionic species: fluoride, chloride, nitrate, and sulfate. This method would replace four different wet chemical

methods now prescribed by the Environmental Protection Agency (EPA) along with the state of Tennessee. The advantages of IC are (1) it is more economical in that it has multi-ion analysis capability, thereby reducing the total time per sample; and (2) the quality of the data is improved because any interference due to the presence of foreign ions is minimized. Statistical comparison of data indicates that the IC method of analysis is equivalent or superior to the prescribed wet chemistry methods for water samples.

62038 **(PB—82-204082) Methods of preventing, detecting and dealing with surface spills of contaminants which may degrade underground water sources for public water systems. Technical report.** Yang, J.T.; Bye, W.E. (Environmental Protection Agency, Washington, DC (USA). Office of Drinking Water). Jul 1979. 118p. NTIS, PC A06/MF A01.

This document presents guidelines and technical documents that can be used by industry, Federal, State and local government Agencies to assist in eliminating or minimizing the effects of spills of contaminants that might adversely affect underground water which supplies, or can reasonably be expected to supply, any public water system.

62039 **Trihalomethanes in chlorinated cooling waters of nuclear reactors.** Hollod, G.J.; Wilde, E.W. (Savannah River Lab., Aiken, SC). *Bulletin of Environmental Contamination and Toxicology;* **28**: No. 4, 404-408(Apr 1982).

The Savannah River Plant (SRP) near Aiken, SC has three operating nuclear reactors and used approximately 100-300 kg/day of chlorine to combat reactor heat exchanger biofouling. SRP cooling water is high in organic carbon and following chlorination, the water is occasionally heated to temperatures exceeding 70° C as it passes through the heat exchangers, forming conditions conducive to the formation of trihalomethanes (THMs), which are known human carcinogens. This study was conducted to examine the production and persistence of THMs resulting from the chlorination and heating of SRP reactor cooling waters. The concentration of total THM in all water samples collected in and around the SRP site were less than 59μg/L, and there was no appreciable increase in the concentrations of THM in the Savannah River downstream of the SRP site. THM levels in all cases were below U.S. Environmental Protection Agency drinking water guidelines (100 μg/L), and it was concluded that THM levels resulting from the chlorination of reactor cooling water at the SRP were insignificant. (JMT)

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 60793, 61014, 61989, 62010

62040 **(PB—82-185091) Advanced technology for radium removal from drinking water: the Flatonia Water Treatment Project. Final report.** Cook, L.M. (Texas State Dept. of Health, Austin (USA). Div. of Occupational Health and Radiation Control). 1981. 67p. NTIS, PC A04/MF A01.

A study was conducted to determine the applicability of using manganese-coated acrylic fibers to remove radium from drinking water. The technique of using manganese-coated fibers to remove radium from drinking water is a simple, effective and economical procedure which is compatible with the operations of a municipal utility crew.

62041 **(RLO—2225-T18-22) Biogeochemistry of transuranic elements in Bikini Atoll lagoon. Final report.** Schell, W.R.; Nevissi, A.; Meyers, J.M. (Washington Univ., Seattle (USA). Lab. of Radiation Ecology). Nov 1978. Contract AT06-76EV70018. 222p. NTIS (US Sales Only). Order Number DE82021989.

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The distribution of transuranic and other radionuclides in the marine environment at Bikini Atoll was studied to better understand the biogeochemical cycling of radionuclides produced during testing of some 23 nuclear and thermonuclear devices between 1946 and 1958. The radionuclides are primarily associated with the coralline sediments. However, the highest radionuclide concentrations are not found at the detonation craters but with the fine particles which have been washed out of the craters in the reef by the currents and deposited downstream. The transuranic elements are distributed widely in sediments over the northwest quadrant of the atoll suggesting that this area serves as a settling basin for particles. The transuranic elements associated with these sediment particles do not remain fixed but are remobilized and distributed asymmetrically in the water column throughout the lagoon. The physicochemical states of plutonium, measured using dialysis and sorption techniques include ~ 15% colloidal and varying amounts in the soluble and particulate fractions depending on sample location. Uptake of these physicochemical states is extensive on plankton with distribution coefficients measured at Bikini between water and plankton of 10^4 - 10^6. The uptake of plutonium in higher organisms decreases with trophic level and low concentrations (~ .001 pCi/g for ^{239,240}Pu) are found in the edible muscle of fish. The half-time for cleansing the reef of contaminant radionuclides has been estimated near the Bravo Crater using measurements made on the viscera of mullet.

62042 **Accumulation rates of Th-230, Pa-231, and some transition metals on the Bermuda Rise.** Bacon, M.P. (Woods Hole Oceanographic Inst., MA); Rosholt, J.N. *Geochimica et Cosmochimica Acta;* **46**: No. 4, 651-666(Apr 1982).

Measurements of ^{238}U, ^{230}U, ^{230}Th, ^{232}Th, ^{231}Pa, Mn, Fe, Co, Ni, Cu, and Zn were made on 23 samples from core GPC-5, a 29-m giant piston core from a water depth of 4583 m on the northeastern Bermuda Rise (33°41.2'N, 57°36.9'W). This area is characterized by rapid deposition of sediment transported by abyssal currents. Unsupported ^{230}Th and ^{231}Pa are present throughout the core but, because of large variations in the sedimentation rate, show marked departures from exponential decay with depth. The trend with depth of the ^{231}Pa/sub ex//^{230}Th/sub ex/ ratio is consistent with the average accumulation rate of 36 cm/1000 y reported earlier on the basis of radiocarbon dating and $CaCO_3$ stratigraphy. When expressed on a carbonate-free basis, concentrations of Mn, Co, Ni, Cu, Zn, ^{230}Th/sub ex/, and ^{231}Pa/sub ex/ all show cyclic variations positively correlated with those of $CaCO_3$. The correlations can be explained by a model in which all of these constituents, including $CaCO_3$, are supplied to the sediments from the water column at a constant rate. Relationships between the metal and ^{230}Th/sub ex/ concentrations permit estimates of the rates at which the metals are removed to the sediment by scavenging from the water column. The results, in μg/cm²-1000 y, are: 4300 +/- 1100 for Mn, 46 +/- 16 for Ni and 76 +/- 26 for Cu. These rates are somewhat larger than ocean-wide averages estimated by other methods, and the absolute rate of ^{230}Th accumulation in GPC-5 averages about nine times higher than production in the overlying water column. This part of the Bermuda Rise and similar bottom-current deposits may act as important accumulators of elements scavenged from seawater.

62043 **(ORNL-tr—4861) Concentration of radium and uranium in foodstuffs and the accumulation of these elements in human teeth.** Belova, R.S.; Lun'kina, Z.P. Translated from *Gigiena i Sanitariya ;* No. 6, 48-51(1967). Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE82020335.

Portions of document are illegible.

A connection has been shown between the concentration of radium in drinking water and its concentration in the human body. However, it is unclear whether its uptake from water or foodstuffs determines the amount of accumulation. The concentration of radium and uranium in foodstuffs and in water and in the teeth of residents from two regions of the Volga River was investigated to identify the daily intake into the human body. (ACR)

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 61977, 62032

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 60861, 61096, 61121, 62054

62044 **(EPRI-EA—2538-SR) Solid-waste environmental studies: the needs and the priorities.** Murarka, I.P. (Electric Power Research Inst., Palo Alto, CA (USA). Environmental Assessment Dept.). Aug 1982. 45p. NTIS, PC A03/MF A01. Order Number DE82906490.

This report presents the rationale behind a program of research into the effects of solid wastes disposal on groundwater quality. Problem topics considered are: inorganic heavy metals, other inorganic elements, organic substances, and dissolved substances. Research needs common to all four areas are identified, as are specialized research requirements. The relevant research projects required to meet the electric utility industry's needs during next five years are discussed and ranked in order of importance. A balanced combination of theoretical, laboratory, and field studies of leaching chemistry and soil attenuation factors is recommended for the short term (one to three years). It is expected that these short-term studies will develop the understanding of cause-and-effect relationships necessary to meet the industry's long-term goal of developing geohydrochemical models that can predict the environmental fate of contaminants.

62045 **(PB—82-190398) Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators, Volume 14. Biological studies.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Marine Pollution Assessment). Nov 1981. 682p. NTIS, PC A99/MF A01.

The contents of the reprint include: the epifauna of three bays (Port Etches, Zaikof Bay and Rocky Bay) in Prince William Sound, Alaska, with notes on feeding biology; and the distribution, abundance, community structure and trophic relationships of the nearshore benthos of Cook Inlet.

62046 **(PB—82-190406) Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators, Volume 15. Biological studies.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Marine Pollution Assessment). Dec 1981. 887p. NTIS, PC A99/MF E01.

The contents of the report include: Identification, documentation and delineation of coastal migratory bird habitat; and an annotated bibliography of literature on Alaska Water Birds.

62047 **(PB—82-190414) Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators, Volume 10. Biological studies.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Marine Pollution Assessment). Jul 1981. 790p. NTIS, PC A99/MF A01.

The contents of the report include: forage fish spawning surveys - southern Bering Sea; effects of oil contamination in the Sea Otter, Enhydra futris; and reconnaissance of intertidal communities in the eastern Bering Sea and the effects of ice - scour on community structure.

5206 Regulations

REFER ALSO TO CITATION(S) 61650, 61651, 61652, 61653

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 60862, 60863, 61627, 61628, 61654

62048 (CONF-8110215—, pp 134-137) **Impact of shifting energy policies on the Illinois consumer.** DeWitt, S.P. 1981. NTIS, PC A08/MF A01.

From 9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties; Chicago, IL, USA (28 Oct 1981).

The rise of consumer fraud schemes for those interested in saving energy and money is rising exponentially with the fuel shortages. Illinois' efforts in protecting the consumer are described. (PSB)

62049 **(NUREG/CR—2859) Evaluation of aircraft-crash-hazards analyses for nuclear power plants.** Kot, C.A.; Lin, H.C.; van Erp, J.B.; Eichler, T.V.; Wiedermann, A.H. (Argonne National Lab., IL (USA)). Jun 1982. Contract W-31-109-ENG-38. 125p. (ANL-CT—81-32). NTIS, PC A06/MF A01 - GPO.

The state of knowledge concerning aircraft crash hazards to nuclear power plants is critically evaluated. This effort is part of a study to analyze the potential effects of offsite hazards upon the safety of nuclear power plants and to develop a technical basis for the assessment of siting approaches for such facilities. The evaluation includes the deterministic modeling of aircraft crash scenarios and threat environments, the estimation of the effects on and the response of the vital plant systems, and the probabilistic aspects of the crash problem, i.e., data bases and statistical methodologies. Also critically reviewed are past licensing experience and regulatory practice with respect to aircraft crash hazards. In general it is found that the data bases, methodologies and modeling approaches are adequate to estimate the threat and plant response. However, this knowledge is not always fully used in specific applications.

62050 **(PB—82-190158) Alaska OCS socioeconomic studies program. Technical report number 55. Monitoring oil exploration activities in the Lower Cook Inlet. Final report.** Klein, R. (Northern Resource Management, Anchorage, AK (USA)). Jul 1980. 226p. NTIS, PC A11/MF A01.

This report describes the technology, personnel, cost and wage data concerned with exploratory operations related to the Lower Cook Inlet sale (CI) area. These figures are shown in tabular form. The report concentrates on the major effects and impacts of the exploration activity on local communities. Such things as public service demands, prices, business cycles, labor effects, community attitudes and others are discussed.

62051 **(PB—82-190166) Alaska OCS socioeconomic studies program. Technical report number 64. Beaufort Sea sociocultural systems update analysis. Final report.** Worl, R.; Worl, R.; Lonner, T. (Worl Associates, Anchorage, AK (USA)). 13 Nov 1981. 248p. NTIS, PC A11/MF A01.

This report updates previously collected SESP information about contemporary conditions in the sociocultural systems of Barrow and Nuiqsut and analyzed the cumulative impacts and changes of the inhabitants due to the pressure of non-traditional authority and economic development and an analytical forecast of trends in the sociocultural system without OCS development from sale 71.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 60862, 60863, 61616

62052 **Energy is good for your health: a plea for completeness in health impact assessments.** Wood, D.E. (Rockwell Hanford, Richland, WA 99352). *Transactions of the American Nuclear Society;* **35**: 17-18(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

62053 **Assessment of actual and perceived risks of energy development.** Cohen, J.J.; Smith, C.E. (LLNL, Livermore, CA 94550). *Transactions of the American Nuclear Society;* **35**: 18-19(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 60861

62054 (NP—2905229) Draft regional environmental impact statement: Gulf of Mexico. (Minerals Management Service, Metairie, LA (USA). Gulf of Mexico OCS Region). Aug 1982. 966p. NTIS.

Portions of document are illegible.

Environmental impacts of proposed outer continental shelf oil and gas lease sales 72 (Central Planning Area), 74 (Western Planning Area), and 79 (Eastern Planning Area) are presented. The offshore marine environment of the Gulf of Mexico as well as the coastal counties/parishes of Florida, Alabama, Mississippi, Louisiana, and Texas are considered. Special potential concerns are sensitive coastal and offshore habitats, endangered species, the commercial fishing industry, offshore marine recreational fishing, major shorefront recreational beaches, cultural resources, tourist activity/industry, and military use/warning areas. Information is presented under the following section headings: purpose and background of the proposed action; alternatives including the proposed action; description of the affected environment; environmental consequences; consultation and coordination; bibliography and special references; preparers (text and visuals); key word index (in attached envelope); and seven appendices. Alternatives for development on each of the three planning areas are considered separately. (JGB)

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 62031

62055 (DOE/EV/02502—20) Integrative studies of thermoregulation in ectothermic vertebrates in aquatic habitats. Annual progress report, 1 October 1981-31 December 1982. Spotila, J.R.; Standora, E.A. (State Univ. Coll., Buffalo, NY (USA)). Aug 1982. Contract AC02-76EV02502. 49p. NTIS, PC A03/MF A01. Order Number DE82022007.

Portions of document are illegible.

Field experiments are underway to determine the behavioral mechanisms by which largemouth bass, Micropterus salmoides, respond to rapid temperature changes in their natural environment. Site specificity of largemouth bass in Pond C has been determined. Laboratory experiments are clarifying the relationship between basking behavior of the turtle, Pseudemys scripta and its nutritional state. Theoretical analysis and mathematical modeling continue and have been used to define the role of body size in the thermoregulation of turtles.

62056 (LBL—10627) Patterns of United States mortality for ten selected causes of death. Selvin, S.; Sacks, S.T.; Merrill, D.W. (Lawrence Berkeley Lab., CA (USA)). 6 Nov 1980. Contract AC03-76SF00098. 40p. NTIS, PC A03/MF A01. Order Number DE82021963.

Portions of document are illegible.

Income, ethnicity, education, and occupation are examples of socio-economic factors associated with the occurrence of disease, whether an investigation focuses on an individual or on an aggregation of individuals. In this study, data aggregated to the county level are used to explore two issues - geographic variation and geographic covariation of ten selected causes of death in the United States. The counties of the United States are characterized by 15 socio-economic variables and age-adjusted mortality rates for the ten selected causes of death. The observed variation among the US counties, as measured by the socio-economic variables, is first assessed, then the geographic variation and covariation are described for each cause of death and, finally, the covariation among causes of death is analyzed after adjusting for the influences of the measured sources of county variation.

5502 Biochemistry

REFER ALSO TO CITATION(S) 61827, 62081, 62084, 62098, 62100, 62106, 62132, 62181, 62182

62057 (BNL—31805) Reversibility of tryptic hydrolysis in a model nonapeptide sequence. Ganu, V.S.; Glass, J.D. (Brookhaven National Lab., Upton, NY (USA); Mount Sinai School of Medicine, New York (USA)). 1982. Contract AC02-76CH00016. 4p. (CONF-820867—1). NTIS, PC A02/MF A01. Order Number DE82022053.

From 17. European peptide symposium; Prague, Czechoslovakia (24 Aug 1982).

Portions of document are illegible.

The tryptic hydrolysis of a peptide related to the activation site of human plasminogen in the presence of varying concentrations of 1,4-butanediol was studied. (ACR)

62058 Vitro packaging of bacteriophage T7 DNA requires ATP. Masker, W.E. (Oak Ridge National Lab., TN). *Journal of Virology;* **43**: No. 1, 365-367(Jul 1982).

Removal of nucleoside triphosphates from extracts prepared from bacteriophage T7-infected Escherichia coli results in a stringent requirement for added ATP to form infective phage particles by in vitro packaging of bacteriophage T7 DNA. Optimal packaging efficiency was achieved at a concentration of about 1.25 mM. Other nucleoside triphosphates could be substituted for ATP, but none of the common nucleoside triphosphates was as effective as ATP in promoting in vitro encapsulation.

62059 Small-angle neutron scattering study of Bence-Jones protein Mcg: comparison of structures in solution and in crystal. Schiffer, M. (Argonne National Lab., IL); Stevens, F.J.; Westholm, F.A.; Kim, S.S.; Carlson, R.D. *Biochemistry;* **21**: No. 12, 2874-2878(8 Jun 1982).

Small-angle neutron scattering measurements in dilute solution were performed on the Mcg Bence-Jones protein dimer, for which accurate atomic coordinates have been determined by crystallographic methods. The measured radius of gyration (R/sub g/) in H_2O buffer is 24.0 +/- 0.4 angstrom and in D_2O buffer is 23.3 +/- O.1 angstrom; the calculated value of R/sub v/ (R/sub g/ in vacuo) is 24.0 angstrom. On the basis of a match point of 44.2% D_2O concentration, the experimental partial specific volume is 0.74 cm^3/g. The experimentally derived molecular weight of 47 000 is in very good agreement with that (45 500) calculated from the amino acid composition. For comparisons with different Fab's (antigen binding fragments) exhibiting various "elbow bends" due to the flexibility of the switch peptide between variable and constant domains of the immunoglobulin chains, calculation of the R/sub g/ value of the Mcg dimer was performed as a function of the elbow bend. The R/sub g/ varied from 22.8 to 26.0 angstrom as the elbow bend was opened from 100° to 180°; the maximum radius of gyration of the particle was 26.5 angstrom with the switch peptide stretched by separating the variable and constant domains by an additional 1.5 angstrom at an elbow bend of 180°.

62060 Reciprocal effects of an inhibitory factor on catalytic activity and noncatalytic cGMP binding sites of rod phosphodiesterase. Yamazaki, A.; Bartucca, F.; Ting, A.; Bitensky, M.W. (Los Alamos National Lab., NM). *Proceedings of the National Academy of Sciences of the United States of America;* **79**: No. 12, 3702-3706(Jun 1982).

In illuminated rod outer segment membranes, GTP and guanosine 5'-[β,γ-imido]triphosphate (p[NH]ppG) have reciprocal effects on cGMP phosphodiesterase (PDEase; 3':5'-cyclic-nucleotide 5'-nucleotidohydrolase, EC 3.1.4.17) activity and cGMP binding to noncatalytic sites on that enzyme. Two micromolar p[NH]ppG increased PDEase activity more than 2-fold while inhibiting cGMP binding more than 40%. Reduction of noncatalytic cGMP binding, which followed addition of p[NH]ppG, was not a result of PDEase activation. Both effects of p[NH]ppG were completely dependent on the presence of bleached rhodopsin. A heat-stable factor has been found to inhibit PDEase activity and also to stimulate cGMP binding to noncatalytic cGMP binding sites. Addition of p[NH]ppG reversed the effects of this factor on both

PDEase activity and cGMP binding. During purification of this material, the activity peaks for both PDEase inhibition and activation of noncatalytic cGMP binding comigrated on both Blue Sepharose CL-6B column chromatography and sucrose density gradients centrifugation, suggesting that the same factor could be responsible for both inhibition of PDEase activity and enhancement of noncatalytic cGMP binding. Limited tryptic proteolysis of PDEase, which markedly reduced cGMP binding to the noncatalytic sites, and experiments using highly purified cAMP (free of cGMP) as substrate for PDEase showed that the binding of cGMP to noncatalytic sites was not required for the heat-stable inhibitory factor to inhibit PDEase activity. We discuss possible relationships between the regulation of PDEase and the binding of cGMP to noncatalytic sites.

62061 **Nickel-containing factor F430: chromophore of the methylreductase of Methanobacterium.** Ellefson, W.L.; Whitman, W.B.; Wolfe, R.S. (Univ. of Illinois, Urbana). *Proceedings of the National Academy of Sciences of the United States of America;* **79**: No. 12, 3707-3710(Jun 1982). Contract AC02-80ER10681.

The yellow chromophore of the methyl-coenzyme M methylreductase of Methanobacterium thermoautotrophicum has been found to be the nickel-containing factor F_{430}. Treatment of ^{63}Ni-labeled methylreductase with 80% aqueous methanol released the radiolabel as well as the yellow chromophore; both properties were associated with a single compound that was found to be identical to F_{430}, the stoichiometry being 1 mol of nickel per mol of F_{430} and 2 mol o F_{430} per mol of methylreductase.

62062 **Structural effects on the circular dichroism of ethidium ion-nucleic acid complexes.** Dahl, K.S.; Pardi, A.; Tinaco, I. Jr. (Univ. of California, Berkeley). *Biochemistry;* **21**: No. 11, 2730-2737(25 May 1982). Contract W-7405-ENG-48.

Binding of the frameshift mutagen ethidium bromide to eight dinucleoside phosphates of different complementary base sequences, to trinucleoside diphosphates with mismatched bases capable of forming bulged structures (CpUpG and GpUpG + CpC), and to calf thymus DNA at different counterion concentrations was studied by optical methods, notably uv-visible spectroscopy, circular dichroism (CD), and fluorescence-detected circular dichroism (FDCD). The ethidium ion intercalated between the base pairs of the minihelix formed by the complementary dimers and displaced the mismatched bases to form bulged structures with the trimers. Complexes with ribodinucleoside phosphates had larger formation constants than their deoxyribose analogues. At very low ionic strength, complexes of calf thymus DNA plus ethidium ion in different salt concentrations showed that the 307-nm CD magnitude increased with decreasing counterion concentration. Implications of the results for theories of the induced CD spectrum of the ethidium ion are discussed.

62063 **Enzyme activity from Escherichia coli that attacks single-stranded deoxyribopolymers and single-stranded deoxyribonucleic acid containing apyrimidinic sites.** Bonura, T.; Schultz, R.; Friedberg, E.C. (Stanford Univ. Medical Center, CA). *Biochemistry;* **21**: No. 10, 2548-2556(11 May 1982). Contract AM03-76SF00326.

We have isolated an enzyme activity from extracts of Escherichia coli that catalyzes the hydrolysis of phosphodiester bonds in the single-stranded deoxyribopolymer (dU.[^{3}H]dT)/sub (2000)/ containing depyrimidinated sites created by enzymatic removal of uracil with uracil-DNA glycosylase. Nondepyrimidinated polymer is not degraded by the enzyme, nor is the depyrimidinated polymer degraded after reduction of apyrimidinic sites with sodium borohydride. The enzyme also degrades circular M18 DNA containing uracil or denatured phage PBS2 DNA (which naturally contains uracil) only after the removal of uracil from these substrates by uracil-DNA glycosylase. Undamaged or depurinated duplex PM2 or ColEl DNA and undamaged M13 single-stranded DNA are not attacked by the enzyme. The activity sediments in glycerol gradients with a relative s value of 4.2 S and has a Stokes radius of 31 angstrom, yielding a calculated M/sub r/~56000. The fractional ratio (f/fo) is calculated at 1.25. The enzyme has no requirement for any known cofactors and is insensitive to inhibition by p-(chloromercuri)benzoate. Activity is inhibited in the presence of adenosine 5'-triphosphate (ATP), tRNA, or high ionic strength and is slightly stimulated by $MnCl_2$ or $CaCl_2$.

62064 **Carbon-13 nuclear magnetic resonance studies of cyanocobalamin and several of its analogues.** Anton, D.L. (Univ. of Minnesota, Minneapolis); Hogenkamp, H.P.C.; Walker, T.E.; Matwiyoff, N.A. *Biochemistry;* **21**: No. 10, 2372-2378(11 May 1982).

The carbon-13 nuclear magnetic resonance spectrum of cyanocobalamin in aqueous solution has been interpreted. The assignments are based on the earlier biosynthetic studies with carbon-13-enriched percursors and on the present systematic analysis of the spectra of cyanocobalamin, cyanocobalamin lactone, cyanocobalamin lactam, cyanoepicobalamin, and several cyanocobalaminmonocarboxylic acids. The interpretation of the spectrum of cyanocobalamin greatly simplified the structure determination of new corrinoids and should prove very helpful in future studies of these compounds. The structures of two cyanocobalamindicarboxylic acids and a cyanocobalaminmonocarboxylic acid lactone have been determined by comparing their carbon-13 magnetic resonance spectra with that of cyanocobalamin.

62065 **Estimations of uronic acids as quantitative measures of extracellular and cell wall polysaccharide polymers from environmental samples.** Fazio, J.A.; Uhlinger, D.J.; Parker, J.H.; White, D.C. (Florida State Univ., Tallahassee). *Applied and Environmental Microbiology;* **43**: No. 5, 1151-1159(May 1982).

A quantitative assay for uronic acids was developed. Polymers containing uronic acids are resistant to quantitative hydrolysis, and the uronic acids, once released, form lactones irreproducibly and are difficult to separate from the neutral sugars. These problems were obviated by the methylation of the uronic acids and their subsequent reduction with sodium borodeuteride to the corresponding alcohol while they were in the polymer and could not form lactones. This caused the polymers to lose the ability to adhere to their substrates, so they could be quantitatively recovered. The hydrolysis of the dideuterated sugars was reproducible and could be performed under conditions that were mild enough that other cellular and extracellular polymers were not affected. The resulting neutral sugars were readily derivatized and then were separated and assayed by glass capillary gas-liquid chromatography. The dideuterated portion of each pentose, hexose, or heptose, identified by combined capillary gas-liquid chromatography and mass spectrometry, accurately provided the proportion of each uronic acid in each carbohydrate of the polymer. Examples of the applications of this methodology include the composition of extracellular polymers in marine bacteria, invertebrate feeding tubes and fecal structures, and the microfouling films formed on titanium and aluminum surfaces exposed to seawater.

62066 **Model for the structure of chromatin in mammalian sperm.** Balhorn, R. (Lawrence Livermore National Lab., CA). *Journal of Cell Biology;* **93**: No. 82, 298-305(May 1982). Contract W-7405-ENG-48.

DNA in mammalian, and most vertebrate sperm, is packaged by protamines into a highly condensed, biochemically inert form of chromatin. A model is proposed for the structure of this DNA-protamine complex which describes the site and mode of protamine binding to DNA and postulates, for the first time, specific inter- and intraprotamine interactions essential for the organization of this highly specialized chromatin. In this model, the central polyarginine segment of protamine binds in the minor groove of DNA, crosslinking and neutralizing the phosphodiester backbone of DNA while the COOH- and NH_3-terminal ends of protamine participate in the formation of inter- and intraprotamine hydrogen, hydrophobic, and disulfide bonds. Each protamine segment is of sufficient length to fill one turn of DNA, and adjacent protamines are locked in place around DNA by multiple disulfide bridges. Such an arrangement generates a neutral, insoluble chromatin complex, uses all protamine sulfhydryl groups for cross linking, conserves volume, and effectively renders the chromatin invulnerable to most extenal influences.

62067 Isoelectric focusing and crossed immunoelectrophoresis of heme proteins in the Escherichia coli cytoplasmic membrane. Kranz, R.G.; Gennis, R.B. (Univ. of Illinois, Urbana). *Journal of Bacteriology;* **150**: No. 1, 36-45(Apr 1982). Contract AC02-80ER10682.

Isoelectric focusing (IEF), agarose electrophoresis, and crossed immunoelectrophoresis (CIE) were used to resolve the heme-containing proteins of the Escherichia coli cytoplasmic membrane after solubilization by Triton X-100. Two bands in IEF stained for heme with pI values of 4.7 and 5.3. One of the bands, with an isoelectric point of pH 5.3, was present only when the cells were grown to late log or stationary phase and possessed N,N,N,'N'-tetramethyl-p-phenylenediamine (TMPD) oxidase activity. The pI 4.7 band was present in cells harvested in both mid-log and stationary phases. Agarose electrophoresis, using larger samples, revealed the same two components apparent by IEF, and, in addition, a third component. The heme-containing fractions were extracted after agarose electrophoresis and subjected to further study. The component which was present in cells grown to stationary phase contained hemes b, a_1, and d. The other two fractions contained only b heme. One of these corresponded to the component with pI 4.7 in IEF and had catalase activity. Antisera were raised against Triton X-100-solubilized cytoplasmic membranes and against the focused TMPD oxidase complex. With these anti-sera, CIE in the presence of Triton X-100 revealed four precipitin complexes containing heme. Three of these corresponded to the components identified by IEF and agarose electrophoresis. We demonstrate that the combined use of IEF and CIE is valuable for analysis of membrane proteins. In particular, this work represents a substantial initial step toward a structural elucidation of the E. coli aerobic respiratory chain.

62068 Separation of aflatoxins from filter cake. Ogawa, I.; Chriswell, C.D. (Ames Lab., IA). *Journal of Chromatographic Science;* **20**: 73-74(Feb 1982).

Size-exclusion chromatography using silianized porous silica microspheres is used to clean up an environmental sample prior to aflatoxin analysis. B_1 and B_2 aflatoxins were found in an anaerobic digestor filter cake sample at concentrations of 1 ppb.

62069 Identification of multiple subclasses of plasma low density lipoproteins in normal humans. Krauss, R.M.; Burke, D.J. (Lawrence Berkeley Lab., CA). *Journal of Lipid Research;* **23**: No. 1, 97-104(Jan 1982).

Density gradient ultracentrifugation of low density lipoproteins (LDL) from 12 normal subjects showed multiple, distinct isopycnic bands. Each band could be assigend to one of four density intervals and the boundaries of these intervals were consistent among all the subjects. Analytic ultracentrifuge flotation (S/sub f/°) rates were assigned to the four density intervals, and there was a strong correlation between peak S/sub f/° rate and peak isopycnic banding position (R/sub f/) of the LDL. Further delineation of distinct subspecies of LDL was afforded by electrophoresis. Densitometric scans of protein-stained gels revealed multiple peaks, and particle diameters were assigned to these peaks using calibration markers. Particles of diameter ≧ 280 A included both IDL and Lp(a). LDL particles with diameters 220 to 272 A could be grouped into seven size intervals defined by electrophoretic peaks in LDL from a group of 68 healthy men and women. Particle diameters decreased with increasing density of the fractions. However, particles within each of the size groups were distributed across a range of densities. Use of a lipid-staining procedure allowed identification of electrophoretic bands in whole plasma which corresponded to those seen in isolated LDL, eliminating the possibility that ultracentrifugation was responsible for formation of the subspecies detected by the gradient gel procedure.

62070 Microdetermination of aliphatic diamines and polyamines with cupric ion. Selig, W. (Lawrence Livermore National Lab., CA). *Microchemical Journal;* **27**: 102-111(1982). Contract W-7405-ENG-48.

Previously reported was a novel analytical method for the determination of 1,2-diaminoethane dinitrate. This method was based on potentiometric titration with standard cupric solution near pH 9. Electromotive forces were monitored with a copper ion-selective indicator electrode and a single-junction reference electrode. In this paper, researchers have extended this work to other diamines, their salts, and polyamines.

62071 Proton activation analysis for the measurement of fluorine in food stamples. Shroy, R.E. (Brookhaven National Lab., Upton, NY); Kraner, H.W.; Jones, K.W.; Jacobson, J.S.; Heller, L.I. *Analytical Chemistry;* **54**: 407-413(1982). Contract AC02-76CH00016.

We have developed a proton activation method for the determination of ^{19}F in food samples based on the use of the $^{19}F(p,p'\gamma)^{19}F$ reaction. Special techniques were used to obtain reproducible target conditions and low background values. Two calibration techniques not dependent on chemical analyses for fluorine gave values comparable to a third method which employed vegetation and cellulose containing from about 20 to 500 ppM (μg/g dry weight) of fluorine. Results are reported for FDA market basket food samples containing less than 10 ppM fluorine (dry weight) and are compared with the values obtained with two methods of chemical analysis for both vegetation and food samples. Proton activation and chemical methods gave values in excellent agreement for the fluorine content of the high fluorine vegetation samples; however, substantial disagreement remains for the low-fluorine food samples.

62072 Combined product and substrate inhibition equation for cellobiase. Hong, J.; Ladisch, M.R.; Gong, C.S.; Wankat, P.C.; Tsao, G.T. (Purdue Univ., West Lafayette, IN). *Biotechnology and Bioengineering;* **23**: No. 12, 2779-2788(Dec 1981). Contract AC02-78CS40071;AS02-76ER02755.

Cellobiase (EC 3.2.1.21) is a β-glucosidase which hydrolyzes cellobiose to glucose and is known to be subject to both product and substrate inhibition. This work reports a model which combines both product and substrate inhibition effects for cellobiase isolated from a commercial preparation of Trichoderma viride from Miles Laboratories (Elkhart, IN). An integrated rate equation is presented which predicts the trends of time courses for hydrolyses of cellobiose at concentrations ranging from 14.6-146mM cellobiose. The constants used in the model (determined from initial rate data) are compared to those reported for cellobiase obtained from other sources of T. viride. Most notable in this comparison is the apparently higher activity and reduced inhibition of this enzyme compared to other sources of cellobiase.

62073 Kinetics for development of gramicidin-induced ion permeabiliity in unilamellar phospholipid vesicles. Clement, N.R.; Gould, J.M. (Univ. of Notre Dame, IN). *Biochemistry;* **20**: No. 6, 1544-1548(1981).

The kinetics for the development of gramicidin-dependent cation permeability in small unilamellar vesicles have been studied by using a vesicle-entrapped, pH-sensitive fluorescence probe to continuously report changes in intravesicular pH. The incorporation of 4 to 5 gramicidin dimers/vesicle was sufficient to increase the proton and counterion permeabilty of that vesicle by several orders of magnitude, so that ionic equilibration following a perturbation of the external medium pH occurred in <1 s. Once a functional gramicidin dimer has become incorporated into one vesicle, it does not readily exchange into another, so that the effects of gramicidin with regard to an individual vesicle can be considered to be essentially all or none. The rate at which transmembrane ion permeability develops in a vesicle suspension was found to depend upon the degree of fluidity of the membrane hydrocarbon interior, being much lower at low temperatures or when cholesterol was present in the bilayer. Low temperatures and increasing bilayer cholesterol content also decreased the number of vesicles affected by a given gramicidin concentration, indicating a decreased membrane solubility for the ionophore at low bilayer fluidities.

62074 Interaction of isocitrate dehydrogenase with (RS)-3-bromo-2-ketoglutarate. A potential affinity label for α-ketoglutarate binding sites. Hartman, F.C. (Oak Ridge National Lab., TN). *Biochemistry;* **20**: No. 4, 894-898(1981). Contract W-7405-ENG-26.

The interaction of oxidize nicotine adenine dinucleotide phosphate dependent isocitrate dehydrogenase (from pig heart) with (RS)-3-bromo-2-ketoglutarate was investigated in an effort to

evaluate the reagent's potential as a selective reagent for α-ketoglutarate binding sites. The enzyme is rapidly inactivated by 0.1 mM bromoketoglutarate at pH 7.4. With increasing concentration of reagent, the reaction shows a rate saturation; the minimum inactivation half-time is 3 min and K/sub inact/ for bromoketoglutarate is 250 μM. Isocitrate and $NADP^+$ protect against inactivation, while ketoglutarate does not. When tested in the assay that monitors isocitrate oxidation, bromoketoglutarate is a competitive inhibitor (K/sub i/=100 μM) of the dehydrogenase. As judged by oxidation of NADPH, bromoketoglutarate is also a substrate for isocitrate dehydrogenase, exhibiting a K/sub m/ of 250 μM and a V/sub max/ comparable to that for isocitrate oxidation. The reduction of bromoketoglutarate is competitively inhibited by isocitrate (K/sub i/ =3 μM) and ketoglutarate (K/sub i/=50 μM). Like the enzyme-catalyzed oxidation of isocitrate, the reduction of bromoketoglutarate is stereospecific, requires divalent metal ions, and shows absolute specificity for NADPH. However, since CO_2 is not required for catalytic turnover of bromoketoglutarate, its reduction is likely comparable to that of oxalosuccinate rather than the reductive carboxylation of ketoglutarate. Although bromoketoglutarate, as a substrate for isocitrate dehydrogenase, clearly has affinity for the active site, the irreversible inactivation of the enzyme by the reagent may result from modification outside the active-site region, since inactivation during catalytic turnover of bromoketoglutarate is not observed.

62075 **Pyranine (8-hydroxy-1,3,6-pyrenetrisulfonate) as a probe of internal aqueous hydrogen ion concentration in phospholipid vesicles.** Clement, N.R.; Gould, J.M. (Univ. of Notre Dame, IN). *Biochemistry;* **20**: No. 6, 1534-1538(1981).

The fluorescence intensity (at 510 nm) of the hydrophilic pyrene analogue 8-hydroxy-1,3,6-pyrenetrisulfonate (pyranine) is strongly dependent upon the degree of ionization of the 8-hydroxyl group (pK/sub a/ = 7.2) and hence upon the medium pH, over the range pH 6-10. Because of its polyanionic character, pyranine does not bind significantly to phospholipid vesicles having a net anionic surface charge. As a result, it is possible to form vesicles in the presence of pyranine which, after removal of external probe by gel filtration, contain pyranine entrapped within the internal aqueous compartment. Once entrapped, pyranine does not readily leak out of the vesicles. Because the fluorescence properties of entrapped pyranine resemble closely the properties of bulk pyranine solution with respect to pH sensitivity, pyranine can be used as a reliable reporter of aqueous pH changes within anionic vesicles. When HCl is rapidly added to a suspension of unilamellar soybean phospholipid (asolectin) vesicles preincubated at alkaline pH, a biphasic decrease in the pH of the vesicle inner aqueous compartment is observed. An initial, very rapid and electrically uncompensated H^+ influx (t/sub 1/2/ < 1 s) results in the generation of a transmembrane electric potential opposing further H^+ influx. This leads to the development of a much slower (t/sub 1/2/ ≅ 5 min), valinomycin-sensitive, proton-counterion exchange which continues until the proton concentration gradient is eliminated. Similar results were obtained in asolectin vesicles prepared by detergent dilution, in sonicated egg phosphatidylcholine vesicles, and in multilamellar asolectin liposomes.

62076 **Circular dichroism, thermal denaturation, and deoxyribonuclease I digestion studies of nucleosomes highly enriched in high mobility group proteins HMG 1 and HMG 2.** Jackson, J.B.; Rill, R.L. (Florida State Univ., Tallahassee). *Biochemistry;* **20**: No. 4, 1042-1046(1981).

Salt-soluble (S) nucleosomes that contain near equimolar high mobility group nonhistone chromosomal proteins HMG 1 and HMG 2 and lack histone H1 were isolated from mouse myeloma nuclei. Comparisons of the sedimentation, near-uv circular dichroism, thermal denaturation, and pattern of DNase I digestion of S nucleosomes with these properties of nucleosome cores or "typical" nucleosomes containing H1 did not detect significant differences, these results indicate that HMG 1 and 2 do not affect the conformation and stability of nucleosomes or nucleosomal DNA and are consistent with the proposal that major functions of HMG 1 and 2 are to replace H1 and maintain the (micro) solubility and accessibility of local chromatin regions. In contrast to these similarities, the initial rate of DNase I digestion of S nucleosomes was ~ 3 times that of chromatin depleted in s nucleosomes. This is consistent with a relation of S nucleosomes to transcription and suggests that subtle factors (not necessarily HMG 1 and 2) determine DNase I susceptibility.

62077 **Effect of hydrostatic pressure on lysozyme and chymotrypsinogen detected by fluorescence polarization.** Chryssomallis, G.S.; Torgerson, P.M.; Drickamer, H.G.; Weber, G. (Univ. of Illinois, Urbana). *Biochemistry;* **20**: No. 14, 3955-3959(1981). Contract AC02-76ER01198.

The effect of hydrostatic pressure upon solutions of chymotrypsinogen and lysozyme at room temperature has been followed by employing a new technique that permits the measurement of fluorescence polarization at pressures of up to 10 kbar. Lysozyme shows a stable, reversible 60% increase in apparent volume when the pressure is raised to 9 kbar. This can be given a simple interpretation in terms of solvent penetration of the structure at higher pressures. In contrast, the results with chymotrypsinogen are time dependent and only partially reversible on release of the pressure. They involve conversion (t/sub 1///sub e/ = 5 min) to a form with a lower rotational rate at approximately 6 kbar and return to a fast-rotating form at higher pressure. This latter form persists on pressure release. The possibility of generating what are clearly metastable conformations, not only in chymotrypsinogen but also in flavodoxins indicates that there are unresolved questions about the relative stability of protein conformations which can be profitably investigated by high-pressure experiments.

62078 **Apparent hydrogen bonding by strongly immobilized spin-labels.** Johnson, M.E. (Univ. of Illinois, Chicago). *Biochemistry;* **20**: No. 12, 3319-3328(1981). Contract W-31-109-ENG-38.

The hyperfine separations of nitroxide spin-labels which are tightly bound within hemoglobin exhibit a substantial temperature dependence even when the hemoglobin is immobilized by freezing or precipitation. It is shown that NO.-HX hydrogen bond formation by the spin-label within its binding site is a good explanation for the observed temperature dependence. Comparative studies using different hemoglobin derivatives and two different spin-labels suggest that the HX group may be some element of the protein matrix and that this hydrogen bond may be a factor in the stabilization of the label within its binding site. The hyperfine separation of a fatty acid spin probe incorporated into aqueous bilayer dispersions of dipalmitoylphosphatidylcholine also exhibits a temperature dependence at low temperature which is qualitatively similar to that of the spin-labeled hemoglobin systems. Saturation transfer electron paramagnetic resonance measurements indicate that label motion is not the source of this temperature dependence. A hydrogen-bond equilibrium between water molecules and the nitroxide NO. group appears to be a plausible souce of the temperature-dependent hyperfine separation in the lipid bilayer system. Small amplitude torsional oscillation or librational motion by the nitroxide may also produce additional changes in the hyperfine separation which are difficult to distinguish from hydrogen-bonding effects under some circumstances. The apparent hydrogen-bond equilibrium exhibits a strong thermal and environmental dependence which may be of importance in a number of biophysical spin-label measurements.

62079 **^{31}P-NMR studies of oriented multilayers formed from isolated sarcoplasmic reticulum and reconstituted sarcoplasmic reticulum - evidence that boundary-layer phospholipid is not immobilized.** McLaughlin, A.C. (Brookhaven National Lab., Upton, NY); Herbette, L.; Blasie, J.K.; Wang, C.T.; Hymel, L.; Fleischer, S. *Biochimica et Biophysica Acta;* **643**: 1-16(1981).

^{31}P-NMR spectra were obtained from oriented multilayer preparations of normal sarcoplasmic reticulum and reconstituted sarcoplasmic reticulum with lipid to protein ratios varying between 42 : 1 and 110 : 1. The dependence of the ^{31}P-NMR spectra on the alignment of the membranes with respect to the magnetic field was used to draw two conclusions about the motion of the phospholipid molecules that contribute to the observed spectra. First, the phosphate group and the two adjacent methylene groups are able to rapidly rotate around the normal to the plane of the membrane. Second, the restricted internal motion of the phosphate group and the glycerol CH_2OP group is very similar to that found in liposomes formed from sarcoplasmic reticulum phospholipids. Calibra-

tion experiments showed that all (100 +- 7%) of the phospholipid molecules in the membrane can be accounted for in the observed spectra. Thus, essentially all the phospholipid molecules in the sarcoplasmic reticulum and the reconstituted sarcoplasmic reticulum membranes have the same motion in the polar headgroup region as found in model bilayer membranes. Since a large fraction of the phospholipid molecules (between one-quarter and one-half, depending on the lipid to protein ratio) are immediately surrounding the calcium-pump protein, we conclude that the calcium-pump protein does not perturb the motion of these boundary-layer lipids.

5503 Cytology

REFER ALSO TO CITATION(S) 62161

62080 **Flow cytometric electronic direct current volume and radiofrequency impedance measurements of single cells and particles.** Hoffman, R.A. (Los Alamos National Lab., NM); Johnson, T.S.; Britt, W.B. *Cytometry (Baltimore);* **1**: No. 6, 377-384(1981).

A flow-system instrument is described that uses direct current and radiofrequency (rf) currents to detect simultaneously the low and high frequency impedance changes produced by biologic cells or particles suspended in saline traversing through a 93-μm diameter sensing orifice. For nonmembranous particles and plastic microspheres both the Coulter direct current volume and rf-parameter signals are proportional to particle volume. Cells having an intact plasma membrane produce rf-impedance changes dependent additionally on the electrical properties of the plasma membrane and intracellular structures. Thus, biologically different cells having the same Coulter direct current volume can be distinguished if they differ in their electrical rf impedance properties.

62081 **Configurations of a polymeric antigen adsorbed to a B-cell membrane.** Wiegel, F.W. (Los Alamos Scientific Lab., NM); Perelson, A.S. *Journal of Theoretical Biology;* **88**: 533-568(1981).

The equilibrium configuration is computed of a linear, haptenated polymer adsorbed to a cell surface, and correlate configurational features of the molecule with its immunological functioning. When a polymeric molecule is bound to a cell the whole molecule is not tied to the surface; rather there are sections which form loops extending into solution, and other sections, trains, which are bound tightly to the surface. The trains cross-link antibody receptors on the B-cell surface in a fashion which restricts their mobility in the plane of the membrane. This type of cross-linking is called restrictive. The computation of equilibrium polymer configurations shows that there is a critical hapten density, below which the polymer does not bind to the surface. As the hapten density increases, the average loop length decreases and the average train length increases. Thus cross-linking becomes restrictive. In this density range immune stimulation is observed. At high hapten densities long trains form, separated by few, very short loops and almost all receptors are cross-linked. Consequently cross-linking may be overly restrictive, freezing receptors into place and generating an abundance of cross-linking or other signals which induce a state of immunological tolerance. (JMT)

62082 **Estimate of the sticking probability for cells in uniform shear flow with adhesion caused by specific bonds.** Bell, G.I. (Los Alamos National Lab., NM). *Cell Biophysics;* **3**: 289-304(1981).

A theory is developed for the aggregation rate of cells in uniform shear flow when the cell-cell adhesion is mediated by bonds between specific molecules on the cell surfaces such as antigen and antibody or lecithin and carbohydrate. The theory is based on estimates of the frequency and duration of cell-cell collisions and of the number of bonds formed and required to hold the cells together. For high shear rates, the sticking probability is a function of A single dimensionless parameter, A, that is proportional to G^{-2}, with G the shear rate. For low shear rates, the sticking probability is a function of A second dimensionless parameter, $A' \sim G^{-1}$. In either case the rate of cell-cell sticking is a maximum when A (or A') $\simeq$ 1.0. For small values of A (or A') the cells collide frequently, but do not stick, whereas for large values of a (or A') the cells collide infrequently, but stick with larger probability. Studies in a Couette viscometer or other flow having approximately uniform shear can test these models.

5504 Genetics

REFER ALSO TO CITATION(S) 62175, 62176

62083 **(STI/PUB—608) Improvement of oil-seed and industrial crops by induced mutations. Panel proceedings series.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1982. 346p. (CONF-8011170—). UNIPUB, 345 Park Ave., South, New York, NY 10010.

From FAO/IAEA conference on improvement of oil-seed and industrial crops by induced mutations; Vienna, Austria (17 Nov 1980).

Nineteen papers are presented under the following sections: introductory papers; genetic improvement of crops producing primarily edible oils; genetic improvement of crops producing primarily industrial raw material; oil-seed quality requirements for industrial processing; concepts of improving biomass production from higher plants; and conclusions and recommendations. Three additional papers are included in the two annexes. (JGB)

62084 **DNA sequence of a mutation in the leader region of the yeast iso-1-cytochrome c mRNA.** Stiles, J.I. (Indiana State Univ., Terre Haute); Szostak, J.W.; Young, A.T.; Wu, R.; Consaul, S.; Sherman, F. *Cell;* **25**: 277-284(Jul 1981).

A plasmid was constructed that selectively integrates adjacent to the CYC1 locus, which determines iso-1-cytochrome c in the yeast Saccharomyces cerevisiae. Different CYC1 alleles can be conveniently recovered by digestion of total DNA from transformed strains with BgI II, a restriction endouclease that does not cut the vector or the CYC1 gene, followed by transformation of Escherichia coli, selecting the ampicillin resistance gene carried on the original vector. This procedure was used to clone the cyc1-362 gene, which contains an alteration in front of the AUG initiation codon. The cyc1-362 mutation causes a deficiency of the iso-1-cytochrome c protein but still allows transcription of the iso-1-cytochrome c mRNA. DNA sequence analysis showed that the cyc1-362 mutation consisted of two single-base-pair substitutions, producing an A → G change 18 nucleotides and a G → A change 30 nucleotides in front of the AUG initiation codon in the mRNA. The A → G change at position -18 resulted in the creation of an AUG triplet, which is proximal to the normal initiation site and out of phase with the normal reading frame. The deficiency of iso-1-cytochrome c is most simply explained by assuming that translation initiates at the more proximal abnormal AUG site but not at the normal AUG site.

62085 **Methods and criteria for deciding whether specific-locus mutation-rate data in mice indicate a positive, negative, or inconclusive result.** Selby, P.B.; Olson, W.H. (Oak Ridge National Lab., TN). *Nutrition Reviews;* **83**: 403-418(1981). Contract W-7405-ENG-26.

The binomial approximation of the UMPU (uniformly most powerful unbiased) test for the equality of 2 binomial proportions is shown to be a highly accurate and easily applied method for testing the hypothesis that a given mouse specific-locus mutation frequency is not higher than the spontaneous mutation frequency (43 mutations in 801 406 offspring, for males). Critical sample sizes have been calculated that show at a glance whether $P < 0.05$. A comparison of the relative efficiencies of the specific-locus test (for gene mutations and small deficiencies) and the heritable-translocation test (for transmissible chromosome rearrangements), in detecting the same proportional increases over the spontaneous frequencies of their respective types of genetic damage, shows that less work is involved in reaching a conclusive result in the specific-locus test. Proposed specific-locus tests using biochemical markers are at a considerable statistical disadvantage compared with the standard test (using 7 visible markers) for which there is available a very large historical control showing a very low mutation rate. (JMT)

5505 Metabolism

REFER ALSO TO CITATION(S) 62100, 62101

62086 **Total body nitrogen in health and disease: effects of age, weight, height, and sex.** Ellis, K.J.; Yasumura, S.; Vartsky, D.; Vaswani, A.N.; Cohn, S.H. (Brookhaven National Lab., Upton, NY). *Journal of Laboratory and Clinical Medicine;* **99**: No. 6, 917-926(Jun 1982).

Total body levels of nitrogen were measured by prompt-gamma neutron activation analysis in 136 healthy adults in the general population (age 20 to 80 years), in 55 cancer patients, and in 20 obese subjects. In order to evaluate the TBN values for the patients, it was necessary to normalize the data for possible differences due to body habitus. This normalization was defined as the ratio of the measured nitrogen level to a predicted nitrogen level derived from the normal population. The parameters of sex, age, height, weight, and fat were used to calculate expected normal values of nitrogen. For the cancer patients, an average TBN deficit of less than 10% was observed. Individual patients, however, showed deviations from the TBN/sub p/ value as large as 28%. For obese patients, the TBN values were normal to slightly high. When adjusted for body size, the deficit of TBN in the cancer patients was approximately half that observd for TBK.

62087 **Uptake of dissolved sulfide by Spartina alterniflora: evidence from natural sulfur isotope abundance ratios.** Carlson, P.R. Jr. (Harbor Branch Foundation, Fort Pierce, FL); Forrest, J. *Science (Washington, D.C.);* **216**: 633-635(7 May 1982).

The difference in the stable sulfur isotope ratios of sulfate and sulfide in marsh pore water was used to verify the uptake of hydrogen sulfide by the salt marsh cordgrass Spartina alterniflora in a North Carolina salt marsh. Most of the plant sulfur derived from pore-water sulfide was recovered as sulfate, an indication that the sulfide had been oxidized within the plant. The anaysis of the sulfur isotope ratios of other coastal halophytes may be a useful technique for determining whether sulfide is taken up by plants in saline wetlands.

5506 Medicine

REFER ALSO TO CITATION(S) 61871, 62129, 62134, 62139, 62144, 62145, 62145, 62148, 62150, 62151, 62153, 62155, 62155, 62157, 62178

62088 **(DOE/EV/04268—9) Biomedical research with cyclotron-produced radionuclides. Progress report, August 1, 1981-July 31, 1982.** Laughlin, J.S.; Benua, R.S.; Gelbard, A.S.; Bigler, R.E. (Sloan-Kettering Inst. for Cancer Research, New York (USA). Biophysics Lab.). 31 Aug 1982. Contract AC02-77EV04268. 61p. (COO—4268-9). NTIS, PC A04/MF A01. Order Number DE82021608.

Portions of document are illegible.

Research progress for the period August 1981 through July 1982 is reported. Subject areas include the evaluation of solid tumor chemotherapy with N-13 labeled L-amino acids, in-vivo studies of L-amino acid metabolism in the liver, myocardium, pancreas and skeletal muscle of man, synthesis, labeling and associated tracer studies of N-13 ammonia, N-13 L-amino acids, C-11 amino acids, radiation exposure control through automation, quantitative positron-1 emission tomography, and data analysis. (ACR)

62089 **(DOE/EV/04268—10) Biomedical research with cyclotron-produced radionuclides. Summary report to the US Department of Energy: 1979-1982.** Reiman, R. (Sloan-Kettering Inst. for Cancer Research, New York (USA). Biophysics Lab.). Aug 1982. Contract AC02-77EV04268. 8p. (COO—4268-10). NTIS, PC A02/MF A01. Order Number DE82021580.

A variety of clinical research projects include the use of Fe-52 citrate in the evaluation of hematopoietic disorders, N-13 ammonia as an imaging agent for the heart and as a tracer for the physiologic study of brain and whole-body ammonia metabolism in patients with severe liver disease, C-11 carbon monoxide in the evaluation of the changes in vascularity in tumors and normal tissues and N-13 L-glutamate and other N-13 labeled amino acids in the evaluation of solid tumors. The primary goal is to develop radiolabeled compounds of physiologic importance, as well as instrumentational and image-processing techniques, which can be used for investigating the nature of and treatment for human disease, particularly cancer. The information gained from in-vivo and in-vitro metabolic studies of the transport and metabolism of physiologic substrates and drugs in patients and in animal models will ultimately lead to improved diagnosis and treatment for cancer, and to reduced morbidity and mortality from that disease. Accomplishments since 1979 are briefly described.

62090 **(DOE/EV/10343—32) Biomedical Computing Technology Information Center (BCTIC). Progress report, August 1, 1981-July 30, 1982.** (Vanderbilt Univ., Nashville, TN (USA). School of Medicine). 30 Jul 1982. Contract AS05-80EV10343. 37p. NTIS, PC A03/MF A01. Order Number DE82020926.

During the past year BCTIC, operating within the Division of Radiological Sciences in the Department of Radiology at Vanderbilt University School of Medicine, has continued to function by collecting, organizing, processing, packaging, and disseminating computing technology. This has been primarily in the form of software. However, the personnel of BCTIC have taken part in several workshops concerned with quality control of clinical computer systems. The acceptance of the user community of BCTIC services has been evidenced by the significant increase in requests for code packages distributed by BCTIC. The mailing list has also increased by 25%. Details of the operation of BCTIC are described at length. (ERB)

62091 **(HRP—0904095/7) Implementation committee report to plan development committee on megavoltage therapy in New Hampshire.** Rodgers, A. (United Health Systems Agency, Inc., Concord, NH (USA)). Jan 1980. 44p. NTIS, PC A03/MF A01.

This report on megavoltage therapy units in New Hampshire presents definitions and background information and reviews personnel and support services; the New Hampshire experience; planning and regulations; and goals, objectives, and actions. Megavoltage therapy is the category of radiation therapy that uses the highest energy radiation, one million electron volts or higher. New Hampshire has three sites at which radiation therapy is provided, and in these sites there are three different types of megavoltage therapy machines. Personnel for whom standards are suggested by the American College of Radiology include: radiation therapists; staff therapists; physicists; radiation therapy technologists; and treatment planning and support workers. Their requirements are summarized in an appendix. A wide range of support services is necessary to ensure the effective use of the megavoltage therapy unit as part of a comprehensive cancer program. Clinical specialists in oncology nursing should be available on a referral or consultation basis for the region. In 1979 New Hampshire had 1,978 megavoltage therapy patients. This is much less than the number of patients currently being treated each year at any New Hampshire unit and less than the number that could support a unit.

62092 **(SAND—82-0943C) Single-ring magnetic cusp ion source.** Brainard, J.P.; O'Hagan, J.B. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 6p. (CONF-821024—2). NTIS, PC A02/MF A01. Order Number DE82020055.

From 10. international symposium on discharges and electrical insulation in vacuum; Columbia, SC, USA (25 Oct 1982).

A low pressure ion source was developed at Sandia National Laboratories which retains the high-performance qualities of the duoplasmatron and duopigatron ion sources but operates in a tube with a gas pressure of 0.25 Pascal. At this pressure, the Sandia source produces a deuterium ion beam of 200 mA through a 1.25 cm^2 aperture with an arc voltage of 165V and an arc current of 13.5A. The D+ fraction is more than 50% and the ion impurity level is less than 0.5%. This new source is the culmination of an effort to find a low pressure substitute for the duopigatron ion source that would enable the cancer therapy D-T neutron generator being developed at Sandia to be built as a non-pumped, low pressure tube.

62093 **Radioimmunoassay of erythropoietin: circulating levels in normal and polycythemic human beings.** Garcia, J.F. (Lawrence Berkeley Lab., CA); Ebbe, S.N.; Hollander, L.; Cutting, H.O.; Miller, M.E.; Cronkite, E.P. *Journal of Laboratory and Clinical Medicine;* **99**: No. 5, 624-635(May 1982).

Techniques are described in detail for the RIA of human Ep in unextracted plasma or serum. With 100 μl of sample, the assay is sensitive at an Ep concentration of approximately 4 mU/ml, and when required, the sensitivity can be increased to 0.4 mU/ml, a range considerably less than the concentration observed in normal human beings. This is approximately 100 times more sensitive than existing in vivo bioassays for this hormone. Studies concerned with the validation of the Ep RIA show a high degree of correlation with the polycythemic mouse bioassay. Dilutions of a variety of human serum samples show a parallel relationship with the standard reference preparation for Ep. Validation of the RIA is further confirmed by observations of appropriate increases or decreases of circulating Ep levels in physiological and clinical conditions known to be associated with stimulation or suppression of Ep secretion. Significantly different mean serum concentrations of 17.2 mU/ml for normal male subjects and 18.8 mU/ml for normal female subjects were observed. Mean plasma Ep concentrations in patients with polycythemia vera are significantly decreased, and those of patients with secondary polycythemia are significantly increased as compared to plasma levels in normal subjects. These results demonstrate an initial practical value of the Ep RA in the hematology clinic, which will most certainly be expanded with its more extensive use.

62094 **Dose evaluation in radiation therapy.** Shalek, R.J. (Univ. of Texas System Cancer Center, Houston). pp 154-159 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

This article discusses the changing and slippery ground upon which the radiation therapist stands as the number of radiation treatments in combination with chemotherapy increases and the awareness of radiation effects such as second malignant neoplasms, impairment of development, fetal damage and genetic changes become more clear. The pressure upon the physicist for increased precision in the control and knowledge of the radiation dose delivered in therapy not only to the tumor but elsewhere in the patient may be supported in clinical findings.

62095 **State and federal regulation of radiation risk.** Nanus, J.M.; Lacker, D.K. (Texas Dept. of Health, Austin). pp 283-292 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

Three agencies have regulations affecting users of ionizing radiation: the Bureau of Radiological Health; the US Nuclear Regulatory Commission; and the various state radiation control agencies. The work of these three groups is described. A brief overview of the regulations and programs concerned with the use of ionizing radiation in medicine is also presented. (RJC)

62096 **Official AAPM response to ALARA (as low as reasonably achievable).** Waggener, R.G. (Univ. of Texas, San Antonio). pp 293-299 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

Implementation of the concept of as low as reasonably achievable (ALARA) evokes strong responses in the radiological community. In an effort to beneficially influence the implementation of ALARA, several members of the American Association of Physicists in Medicine have developed an alternative model program for maintaining safe occupational radiation exposures. This program is described. (RJC)

5507 Microbiology

REFER ALSO TO CITATION(S) 60897, 60898, 60907, 60908, 62058, 62181, 62182

62097 **(AD-A—114424/5) The role of microorganisms in marine corrosion processes. Annual technical report no. 1, 1 Jul 81-30 Jun 82.** Mitchell, R.; Boyle, P.J. (Harvard Univ., Cambridge, MA (USA). Lab. of Microbial Ecology). May 1982. 38p. NTIS, PC A03/MF A01.

This report describes research into the role of bacteria in marine corrosion processes. During the past year we have developed methods for quantitative assessment of bacterial attachment and growth on metal surfaces. We have shown that few marine bacteria attach to metals coated with organic films. However, these bacteria quickly adapt to the new environment and grow rapidly. We are currently developing methods to assay organic acid production by these bacteria at crack and crevice corrosion sites. High pressure liquid chromatography is being used for these analyses.

62098 **Identification of the initiation site of poliovirus polyprotein synthesis.** Dorner, A.J. (State Univ. of New York, Stony Brook); Dorner, L.F.; Larsen, G.R.; Wimmer, E.; Anderson, C.W. *Journal of Virology;* **42**: No. 3, 1017-1028(Jun 1982).

The complete nucleotide sequence of poliovirus RNA has a long open reading frame capable of encoding the precursor polyprotein NCVPOO. The first AUG codon in this reading frame is located 743 nucleotides from the 5′ end of the RNA and is preceded by eight AUG codons in all three reading frames. Because all proteins that map at the amino terminus of the polyprotein (P1-1a, VPO, and VP4) are blocked at their amino termini and previous studies of ribosome binding have been inconclusive, direct identification of the initiation site of protein synthesis was difficult. We separated and identified all of the tryptic peptides of capsid protein VP4 and correlated these peptides with the amino acid sequence predicted to follow the AUG codon at nucleotide 743. Our data indicate that VP4 begins with a blocked glycine that is encoded immediately after the AUG codon at nucleotide 743. An S1 nuclease analysis of poliovirus mRNA failed to reveal a splice in the 5′ region. We concluded that synthesis of poliovirus polyprotein is initiated at nucleotide 743, the first AUG codon in the long open reading frame.

62099 **The effect of D-glucose and D-fructose on the activity of 4b-glucosidase in Trichoderma reesei C30 cellulase.** Woodward, J.; Arnold, S.L. (ORNL, Oak Ridge, TN 37830). pp 543 of Trends in the biology of fermentations for fuels and chemicals. Hollaender, A. New York, NY; Plenum (1981).

From Trends in the biology of fermentations for fuels and chemicals; Upton, NY, USA (7 Dec 1980).

An abstract of an article that describes the effect of D-glucose and D-fructose on the activity of 4b-glucosidase in Trichoderma reesei C30 cellulase, and of the obstacles that need to be overcome before the enzymatic hydrolysis of cellulose to glucose is realized commercially is presented. As a result of this inhibition, cellobiose accumulates which inhibits the other cellulase components and effects a drastic reduction in the rate of the enzymatic hydrolysis of cellulose. The effect of exogenously added D-glucose and D-fructose on the initial rates of cellobiose and rho-nitrophenyl-4b-glucoside (PNPG) hydrolysis, catalysed by the 4b-glucosidase component in T. reesei C30 cellulase, was determined.

62100 **Physiology of thermophilic bacteria.** Ljungdahl, L.G. (Univ. of Georgia, Athens). *Advances in Microbial Physiology;* **19**: 149-243(1979).

Thermophilic micro-organisms have all of the properties normally found in mesophilic micro-organisms. These include metabolic pathways, regulatory mechanisms such as allosteric or feedback control, repression and induction of protein synthesis, growth yields and metabolic rates. The main difference between thermophiles and mesophiles is the former's capacity to grow at high temperatures. The basis for this capacity is the thermophile's capability to synthesize proteins, complex structures and membranes that are

stable or are stabilized and functional at thermophilic temperatures. It is proposed that the maximum and minimum growth temperatures are normally determined by properties associated with proteins, and that the membrane plays a lesser role in determining these temperatures. Enzymes and other proteins from thermophiles, except for having higher thermostability, are very similar to corresponding proteins from mesophiles. The higher thermostability is generally dependent on subtle changes in the composition and sequence of the amino acids and rarely dependent on non-proteinaceous factors. Although over 100 proteins have been purified from thermophiles and compared with corresponding proteins from mesophiles, the exact nature of the higher thermostability has yet to be determined in a protein from a thermophile.

5508 Morphology

REFER ALSO TO CITATION(S) 62136

5509 Pathology

REFER ALSO TO CITATION(S) 62134

62101 **Erythropoietin elevation in the chronically hyperglycemic fetal lamb.** Philipps, A.F. (Univ. of Connecticut Health Center, Farmington) Widness, J.A.; Garcia, J.F.; Raye, J.R.; Swartz, R. *Proceedings of the Society for Experimental Biology and Medicine;* **170**: No. 1, vp(May 1982).

The effects of chronic fetal glucose infusion upon fetal oxygenation and endogenous erythropoietin (Ep) production were studied using the chronically catheterized fetal lamb. Fetal glucose infusion at rates between 5 and 20 mg/kg/min resulted in sustained fetal hyperglycemia. During glucose infusion (maximal glucose concentration achieved = 55.4 +/- 3.7 mg/dl) fetal arterial oxygen contents fell from 5.8 +/- 0.9 to 4.2 +/- 1.0 ml/dl while no changes were observed in simultaneously sampled, noninfused twins. Although plasma insulin concentration rose in the infused fetuses, the elevations were inconstant and no relationship between fetal plasma insulin concentration and decrement in fetal oxygen content was evident. The changes in plasma Ep concentration were noted prior to any significant fetal metabolic acidosis (as evidence of tissue hypoxia) and no changes in plasma Ep concentration were observed in simultaneously sampled noninfused twins. No relationship was apparent between fetal arterial plasma insulin and Ep concentrations. Since neither fetal anemia nor hemodilution occurred in these preparations, glucose-induced fetal hyposemia is the likely mechanism behind elevated fetal Ep concentrations in these experiments. Similarities between this animal model and human fetuses and infants of diabetic mothers suggest that chronic in utero hypoxemia may be a common feature responsible for such diverse abnormalities as polycythemia, hyperbilirubinemia, and late fetal demise. The mechanism behind the glucose-induced fetal hypoxemia is not known.

62102 **Skin lesions in the tail of the spiny dogfish, Squalus acanthias L.** Woodhead, A.D. (Brookhaven National Lab., New York). *Journal of Fish Diseases;* **5**: 71-74(1982).

There are numerous reports of diseases and lesions of the major organs of a wide spectrum of bony fishes. By contrast, very few cases have been reported from elasmobranchs. This lack of information may reflect the fact that commercial exploitation of elasmobranch populations has been limited, although for several decades there have been fisheries for the spiny dogfish, Squalus acanthias L., in European waters. In both cases, many thousands of spiny dogfish have been sampled for population analysis. Further, the spiny dogfish has been dissected in senior biology courses in the UK for about 30 years and probably 5000 students take these courses annually. It is remarkable, with these numbers dissected, that so few lesions have been recorded. During the summer of 1980, whilst working at the Mount Desert Island Biological Laboratory, Maine, researchers sampled a large spiny dogfish which had a prominently engorged tail with numerous skin lesions. The fish was a mature female 100 cm long, weighing 6.5 kg, which was carrying 16 embryos in their second year of development. The dogfish was also remarkable in that one of the embryos had a marked developmental abnormality, its spinal column being severely twisted. Developmental damage appears to be unusual in dogfish and the embryo was examined further to see whether the damage might be related to the lesion of the mother.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 62101, 62160, 62170, 62171, 62179, 62180, 62182

62103 **The chemical mimicking of the mechanical stimulation, photoinhibition, and recovery from photoinhibition of bioluminescence in the marine dinoflagellate, Gonyaulax polyedra.** Hamman, J.P.; Seliger, H.H. (Johns Hopkins Univ., Baltimore, MD). *Journal of Cellular Physiology;* **111**: No. 3, 315-319(Jun 1982).

Mechanically stimulable bioluminescence and photoinhibition of sensitivity to mechanical stimulation in the marine dinoflagellate Gonyaulax polyedra can be mimicked by a number of cations, proportional to the logarithm of their external concentrations. The data are consistent with mechanical stimulability as a membrane depolarization resulting in an increase in H^+ ions at bioluminescence sites and with photoinhibition as a hyperpolarization of the cell membrane.

62104 **Platelet-associated complement C3 in immune thrombocytopenic purpura.** Myers, T.J.; Kim, B.K.; Steiner, M.; Baldini, M.G. (Brown Univ., Pawtucket, RI). *Blood;* **59**: No. 5, 1023-1028(May 1982).

Platelet-associated C3 (PA-C3) was measured with a quantitative immunofluorescence assay. With this assay, PA-C3 levels were determined for 78 normal volunteers, 30 patients with immune thrombocytopenic purpura (ITP), and 20 patients with nonimmune thrombocytopenias. Platelet-associatd IgG (PA-lgG) levels were also measured with our standard quantitative immunofluorescence assay. All patients with nonimmune thrombocytopenias and ITP in remission had normal PA-C3 levels. Twenty-four patients with active ITP wre classified into 3 groups: 9 (38%) with increased PA-IgG and normal PA-C3 levels, 10 (42%) with elevated PA-C3 and PA-IgG levels, and 5 (20%) with increased PA-C3 values only. A direct correlation was found between PA-C3 and PA-IgG levels. PA-IgG levels were higher in the group of patients with elevated PA-C3 levels than in those with normal values. Platelet survival studies showed reduced survival times of 1.5-2.5 days for the 5 patients with elevated PA-C3 levels only. Elevated PA-C3 levels returned to normal in 7 ITP patients whose platelet counts increased in response to corticosteriod therapy or to splenectomy. Therefore, PA-C3 and PA-IgG assays can be used to identify patients with ITP, to follow their response to therapy, and to classify them into immunologic subgroups similar to red cell classifiation by Coombs' testing in immune hemolytic anemia.

62105 **Evaluation of the tritiated water method for measurement of transpiration in young Pinus taeda L.** Luvall, J.C. (Univ. of Georgia, Athens); Murphy, C.E., Jr. *Forest Science;* **28**: No. 1, 5-16(Mar 1982).

The tritiated water (HTO) technique was evaluated as a method for measurement of transpiration of young loblolly pine. Twenty-one millicuries of tritium in 3 ml of water were injected into holes drilled at the base of the trees. The transpiration rate was estimated to average 8.3 liters/day per tree for three trees injected in February and 40.4 liters/day for a single tree injected in July. Several methods of collecting the water from the trees for tritium analysis were evaluated. The collection of water by condensation in clear plastic bags sealed around branch tips proved to be a simple, reliable method of collecting water. Difference in the integral tritium activity with distance from the injection site were found. Serious errors in the estimation of transpiration are possible if the difference in tritium activity in the canopy are not taken into account. The activity measured in the water collected nearest the injection point provided good estimation of transpiration when compared to evaporation determined by a soil water balance or by the Penman-Monteith evaporation formula.

62106 **Blood: bone equilibrium.** Neuman, M.W. (Univ. of Rochester School of Medicine and Dentistry, NY). *Calcified Tissue International;* **34**: 117-120(1982). Contract AC02-76EV03490.

The conundrum of blood undersaturation with respect to bone mineralization and its supersaturation with respect to bone's homeostatic function has acquired a new equation. On the supply side, Ca^{2+} is pumped in across bone cells to provide the needed Ca^{2+} x P/sub i/ for brushite precipitation. On the demand side, blood is in equilibrium with bone fluid, which is in equilibrium with a mineral more soluble than apatite. The function of potassium in this equation is yet to be found.

62107 **Influence of parathyroid hormone on bone cell ultrastructure.** Matthews, J.L. (Baylor Univ. Medical Center, Dallas, TX); Talmage, R.V. *Clinical Orthopaedics and Related Research;* No. 156, 27-38(May 1981).

A study in rats demonstrated that morphologic changes in the bone osteocytes and osteoblasts are produced following parathyroid hormone (PTH) injection into thyroparathyroidectomized animals. It further showed that similar changes occur in normal rats as the result of extended fasting. The most significant morphologic alterations involved surface microvilli and blebs as determined by scanning electron microscopy. Transmission electron microscopy studies showed alterations in the cisternae of the rough endoplasmic reticulum. Additionally, cell shape varied markedly from the control cuboidal morphology. These morphologic changes occurred during peak periods of plasma calcium change and returned to control morphology as plasma calcium levels normalized. The study supports the concept that osteocytes and lining cells on the surface of bone play a role in maintenance of plasma calcium concentrations. (JMT)

62108 **Ultrastructural and physiological evidence for calcitonin-induced postprandial calcium storage in bones of rats.** Vanderwiel, C.J.; Talmage, R.V. (Univ. of North Carolina, Chapel Hill). *Calcified Tissue International;* **33**: 417-424(1981).

The postulate tested was that calcitonin directs a portion of the calcium absorbed from food into temporary storage at surfaces of bone. The study utilized young adult rats in which the parathyroid glands had been autotransplanted. The experiments demonstrate both physiological and bone morphological differences between TI and TX rats which can be negated by postprandial calcitonin injection to TX animals. They support the postulate that the secretion postprandially aids in the conservaton and storage of ingested calcium. (JMT)

5520 Public Health

REFER ALSO TO CITATION(S) 61994, 62071, 62135

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 62105

62109 **(CONF-820858—1) Genetic, site, and within-three variation in specific gravity and moisture content of young sycamore trees.** Land, S.B. Jr.; Tuskan, G.A.; Dicke, S.G.; Patterson, P.E. (Mississippi State Univ., Mississippi State (USA); Texas A and M Univ., College Station (USA); Associated Resource Consultants, Flagstaff, AZ (USA)). 1982. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01. Order Number DE82020813.

From Technical Association of Pulp and Paper Industries conference; Asheville, NC, USA (30 Aug 1982).

Portions of document are illegible.

Specific gravities (SG), moisture contents (MC), and green volumes were determined for stem wood, stem bark, limb wood, and limb bark of 822 six-year-old sycamore trees growing in progeny-test plantations at five sites in Mississippi. Volume was distributed as follows: stem wood (66%), stem bark (7%), limb wood (23%), and limb bark (4%). Specific gravities of both wood and bark declined with increasing height in the stem, but bark SG was greater than wood SG at large diameters and less than wood SG at small diameters. Moisture contents increased with increasing height in the stem. Neither SG nor MC was affected greatly by limb diameter size within the range of 0 to 4 cm. Limb wood SG was consistently greater than stem wood SG. Sites differed in SG and MC, with those sites providing the fastest volume growth having the lowest SG and highest MC. Genetic variation among trees within stands was highly significant for SG and MC, and there was no genetic correlation of these two wood properties with volume. Heritabilities for mass selection were 0.68 for stem wood SG, 0.14 for stem bark SG, 0.25 for stem MC, and 0.08 for stem volume. No genetic differences among geographic sources and no genotype-by-site interactions were detected. Opportunities for genetic improvement are discussed, and implications for utilization of short-rotation sycamore plantations are considered.

62110 **(DOE/ER/02528—T1) Cellular approach to agricultural genetics. Final report, December 1, 1974-November 30, 1977.** Carlson, P.S. (Michigan State Univ., East Lansing (USA)). 1977. Contract AC02-76ER02528. 15p. NTIS, PC A02/MF A01. Order Number DE82019422.

This project was focused upon identifying how genetic manipulation of higher plant cells cultured in vitro could provide new methods for crop improvement. Work has taken three major directions: (1) attempts to define conditions for the in vitro culture and subsequent regeneration of entire plants from somatic cells of important crop species, (2) attempts to define novel selection schemes to allow recovery of a wide range of mutant phenotypes, and novel genetic techniques to transfer this genetic information, and (3) a direct interaction with plant breeders in attempting to make use of these in vitro techniques in ongoing crop improvement programs. We have accomplished routine regeneration of entire plants from established long term in vitro callus cultures of wheat and tomato, and from suspension cultures of barley and potato. We have defined conditions for the isolation of temperature sensitive variants of plant cells and for the recovery of mutants altered in tissue specific characteristics. We have utilized two-dimentional gel electrophoresis to characterize the range of polypeptides present in cells cultured in vitro and to observe their alterations in variant cell lines. We have begun the process of defining by using heterotic hybrids which biochemical and physiological traits of whole plants are limiting final yield characteristics. We have defined conditions for chromosome isolation from plants, and initially characterized a higher plant-bacterial recombinant DNA system. We are interacting directly with breeders and individuals involved in plant improvement in projects involving cereal grains, grain legumes, potatoes and other field horticultural crops.

62111 **(DOE/ER/02528—T2) Cellular approach to agricultural genetics, December 1, 1974-July 31, 1979.** Carlson, P.S. (Michigan State Univ., East Lansing (USA)). 1979. Contract AC02-76ER02528. 15p. NTIS, PC A02/MF A01. Order Number DE82020383.

Work focussed on identifying how genetic manipulation of higher plant cells cultured in vitro could provide new methods for crop improvement. Research has taken three directions: (1) attempts to define conditions for the in vitro culture and subsequent regeneration of entire plants from somatic cells of important crop species; (2) attempts to define novel selection schemes to allow recovery of a wide range of variant phenotypes, and novel genetic techniques to transfer this genetic information; and (3) a direct interaction with plant breeders in attempting to make use of these in vitro techniques in ongoing crop improvement programs.

62112 **Effects of prerigor pressurization on the emulsifying capacity of muscle protein.** Elgasim, E.A.; Kennick, W.H.; Anglemier, A.F.; Elkhalifa, E.A.; Koohmaraie, M. (Oregon State Univ., Corvallis). *Journal of Food Processing and Preservation;* **47**: No. 3, 861-863(May 1982). Contract FG01-80CS15013.

The emulsifying capacities of pressure treated and control muscle homogenates, sarcoplasmic protein and myofibrillar proteins of ovine and bovine longissimus muscles were determined at 2, 6, 24 and 168 hr postmortem. The pH of the intact muscle, muscle homogenate and myofibrillar protein extract were taken at these times. Before onset of rigor mortis, the emulsifying capacity of

muscle homogenate from the control samples was higher than the pressure treated samples. At 24 and 168 hr postmortem, the pressure treated and control samples were not significantly different ($P>0.05$) for emulsifying capacity. At 2 hr postmortem, the emulsifying capacity of myofibrillar protein extract from control samples was higher ($P<0.05$) than that from pressure treated samples; thereafter, the emulsification curve for the pressure treated samples was higher than that of the control. The emulsification capacity of sarcoplasmic proteins from control muscles was slightly, but consistently, higher than that from pressure treated muscles throughout the test period. Overall, the emulsification capacity of muscle proteins was not detrimentally affected by pressure treatment.

62113 **Effect of hot boning and pre-rigor pressurization of beef on factors of economic importance.** Schumann, M.S.; Kennick, W.H.; Rock, D.F. (Oregon State Univ., Corvallis). *Journal of Food Processing and Preservation;* 47: No. 3, 864(May 1982).

One randomly selected side from each of ten beef carcasses was hot boned and subjected to hydrostatic pressurization (103.5 MNm^{-2}) for 2 min; the corresponding control sides were cold boned at 48 hr. Twelve boneless wholesale beef cuts were removed from each side and evaluated for boning yields, purge loss, wholesale cut yields, and trimmed retail cut yields. No significant differences were found in yield of bone, fat, or lean trim between hot- and cold-boned sides, nor was there any difference in purge loss between the 12 control and pre-rigor pressurized (PRP) boneless wholesale cuts ($P > 0.05$). There was a higher ($P < 0.05$) yield in total wholesale cuts with the hot-boned PRP-treated sides. Some noticable distortion occurred in three of the five major PRP-treated boneless wholesale cuts processed into steaks, reducing their trimmed retail yield. Overall, there was no significant difference ($P > 0.05$) in total trimmed retail yield between conventional (control) and hot-boned PRP sides.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 61871, 62009, 62094, 62095, 62161, 62163

62114 **(BNL—31778) Empirical evaluation of cell critical volume dose vs. cell response function for pink mutations in tradescantia.** Varma, M.N.; Bond, V.P. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 16p. (CONF-820931—4). NTIS, PC A02/MF A01. Order Number DE82021560.

From 8. symposium on microdosimetry; Julich, F.R. Germany (27 Sep 1982).

Microdosimetric spectra for 0.43, 1.8, and 14.7 MeV neutrons, and for 215 kVp x rays and 1250 keV gammas were used in conjunction with relative biological effectiveness (RBE) values for pink mutations in Tradescantia to obtain an effectiveness function (i.e., a cell critical volume dose vs. cell response function). This effectiveness function (or hit size weighting function) provides the probability of inducing a biological effect of interest (in the present study, pink mutations in Tradescantia) as a function of lineal energy density y. In a preliminary analysis the critical value of y above which pink mutations are seen was 4.5 keV/μm, and the value of y at which the probability reaches unity was 115 keV/μm. Idealized but approximate event size distributions for mono-LET particles ranging from 10 to 5000 keV/μm were generated, and these distributions were weighted by the effectiveness function to determine the pink mutation frequencies. Results are compared with measured pink mutation frequencies for 11 keV/μm (^{12}C) and 31 keV/μm (^{20}Ne) ions.

62115 **(DOE/EV/03571—23) Measurement of DNA size by fluorescence-fluctuation spectroscopy.** Hutchinson, F. (Yale Univ., New Haven, CT (USA). Dept. of Molecular Biophysics and Biochemistry). 12 Apr 1982. Contract AC02-76EV03571. 25p. (COO—3571-23). NTIS, PC A02/MF A01. Order Number DE82021228.

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This report covers research on measuring the size of very large DNA molecules by fluorescence-fluctuation spectroscopy. The primary reason was to measure the formation of DNA double-strand breaks in mammalian cells by agents such as ionizing radiation, and to measure the repair of these breaks. Fluorescence-fluctuation spectroscopy was employed because it is known to be able to measure the size of DNA of molecular weight greater than 10^9 (Weissman, et al., 1976). Most of this report is devoted to the techniques of fluorescent fluctuation spectroscopy. Using the procedures described here, it is likely that measurements could be made of DNA of molecular weight 10^{10}, which would be formed in mammalian cells given 1000 rads of x-rays.

62116 **(EIR—434) Human evidence on the shape of the dose-response curves for radiation carcinogenesis.** Burkart, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1981. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82906235.

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The carcinogenic effects of high levels of ionizing radiation are well understood. However, the somatic risk from low doses is highly disputed. Risk estimates for low doses have to be derived indirectly by extrapolation from high exposure data and are dependent on assumptions about the form of the dose-response curve. Although radiobiological theories predict a quadratic term in the dose-response equation, the epidemiological data available cannot exclude the possibility of a pure linear relationship. In some cases, apparent thresholds may result from latent periods inversely related to dose. The shape seems also to differ with the type of cancer induced. Studies on uranium miners, atomic bomb survivors, and irradiated patients are reviewed with emphasis on the shape of the dose-response curve. The credibility of reports claiming a large cancer risk from low levels of radiation is assessed. The feasibility of a new study in an area of high natural background is explored, and the influence of the uncertainties concerning the effect of low level radiation on future exposure limits set by regulatory bodies is discussed. (ERB)

62117 **(EIR—435) Radon and energy-efficient homes.** Burkart, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). Abt. Strahlenueberwachung; New York Univ., NY (USA). Inst. of Environmental Medicine). 18 Apr 1981. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82906204.

Radon and its daughters in indoor air are presently responsible for dose equivalents of about 31 mSv/y (3 rem/y) to parts of the respiratory tract. Linear extrapolation from the dose response values of uranium miners heavily exposed to radon and its decay products would suggest that almost all lung cancers in the non-smoking population are caused by environmental ^{222}Rn. Using epidemiological data on the types of lung cancer found in non-smokers of the general public as compared to the miners, a smaller effect of low level radon exposure is assumed, which would result in a lung cancer mortality rate due to radon of about 10 deaths per year-million or 25% of the non-smoker rate. Higher indoor radon concentrations in energy efficient homes mostly caused by reduced air exchange rates will lead to a several-fold increase of the lung cancer incidence from radon. Based on the above assumption, about 100 additional lung cancer deaths/year-million will result both from an increase in radionuclide concentrations in indoor air and a concomitant rise in effectiveness of radiation to cause cancer with higher exposure levels. Possibilities to reduce indoor radon levels in existing buildings and costs involved are discussed.

62118 **(HEHF—22) United States Transuranium Registry summary report to June 30, 1974 to USAEC Division of Biomedical and Environmental Research.** Norwood, W.D.; Newton, C.E. Jr. (Hanford Environmental Health Foundation, Richland, WA (USA)). Jun 1974. Contract AC06-76RL01837. 49p. NTIS, PC A02/MF A01. Order Number DE82015461.

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This report gives some of the highlights of the US Transuranium Registry since its inception in late 1968 together with more detailed information concerning the activities for the year ending April 30, 1974. Articles are referred to which describe autopsy

studies to determine plutonium body content, performed since 1949 for the purpose of evaluating plant health safety programs. The purpose of the Registry is described and its administrative direction is discussed. The Registry is a data collecting agency whose success depends upon how well the data is collected by the cooperating companies is described.

62119 **(HEHF—24) United States Transuranium Registry annual report October 1, 1975-October 1, 1976 to ERDA Division of Biomedical and Environmental Research.** Breitenstein, B.D. Jr.; Norwood, W.D.; Newton, C.E. Jr. (Hanford Environmental Health Foundation, Richland, WA (USA)). Dec 1976. Contract AC06-76RL01837. 25p. NTIS, PC A02/MF A01. Order Number DE82015464.

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The US Transuranium Registry is a center for collecting precise information about the occupational effects of transuranic elements on man. To date 13,943 past and present transuranium workers have been tabulated. Health, mortality, causes of death and transuranic organ depositions are being studied. Bryce D. Breitenstein, Jr., M.D. was named Director of the Registry in July 1976. The Los Alamos Scientific Laboratory is directing the epidemiological portion of a plutonium worker health study with George Voelz, M.D. and Louis Hempelmann, M.D. serving as principal investigators. The USTR is affiliated with this study. USTR statistical data shows progressive acquisition of information for 1975 and 1976. ERDA contractor and NRC licensee activities at participating sited are discussed. Preparation of the input format to record and store USTR data has been completed and is ready for trial operation. USTR educational and informational activities were extensive and varied. Many queries arose from the use of published Registry autopsy data by Ralph Nader's associate Dr. S. Wolfe. There was continued cooperation with representatives of the British Atomic Energy Authority in their efforts to develop a plutonium registry.

62120 **(HEHF—28) United States Transuranium Registry annual report October 1, 1977-October 1, 1978 to DOE Office of Health and Environmental Research.** Breitenstein, B.D. Jr.; Norwood, W.D.; Newton, C.E. Jr. (Hanford Environmental Health Foundation, Richland, WA (USA)). Jan 1979. Contract AC06-76RL01837. 34p. NTIS, PC A03/MF A01. Order Number DE82015467.

The US Transuranium Registry (USTR) serves as a center for the acquisition and recording of information of the transuranic elements in man and their effects on man. To data 15,045 US transuranium workers have been tabulated, authority for 1048 autopsies obtained, and 93 autopsies granted. Department of Energy contractor and National Regulatory Commission licensee activities at participating sites are discussed. A significant increase in participation from the Savannah River plant has been received during the past year. The low level transuranic measurement laboratory analyzing tissue specimens for the USTR (except Rocky Flats specimens) was transferred from Battelle Pacific Northwest Laboratory to Los Alamos Scientific Laboratory. Dr. Charles W. Mays was appointed Chairman of the USTR Advisory Committee upon the resignation of Dr. James H. Sterner. To improve the quality of autopsy tissue for analysis prosectors were appointed at the Hanford, Rocky Flats, and Los Alamos sites. USTR educational and informational activities were extensive and varied.

62121 **(HEHF—30) United States Transuranium Registry. Annual report, 1 October 1978-1 October 1979 to DOE Division of Biomedical and Environmental Research.** Breitenstein, B.D. Jr.; Newton, C.E. Jr. (Hanford Environmental Health Foundation, Richland, WA (USA)). Jan 1980. Contract AC06-76RL01837. 53p. NTIS, PC A04/MF A01. Order Number DE82015468.

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This Registry was established in 1968 to protect the interests of workers, employers, and the public by serving as a national focal point for the acquisition and provision of precise information about transuranics in humans. This purpose is accomplished by studying the distribution and concentration of transuranics in man through the analysis of autopsy tissues of accupationally exposed workers; by comparing the estimates of body or chest burdens made during the life of a worker with estimates based on the analysis of tissues obtained after death; by seeking in autopsy histopathological changes that might be attributed to the effects of transuranics; and by studying the findings of animal experiments involving transuranics and comparing them with data from human beings who had received a transuranic deposition. Seven DOE contractor laboratories and several contractor licensees participate in the Registry by encouraging their staff members to sign releases of health physics and medical information and releases for autopsies. Data files and release records are kept at the Hanford Environmental Health Foundation, Richland, Washington.

62122 **(HEHF—30-App.4) United States Transuranium Registry. Annual report, October 1, 1978-October 1, 1979. HEHF 30.** (Hanford Environmental Health Foundation, Richland, WA (USA)). 1 Jun 1982. Contract AC06-76RL01837. 203p. NTIS, PC A10/MF A01. Order Number DE82015469.

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Appendix No. 4 provides greater detail for the USTR autopsy cases than is presented in the summary form in the Annual Report for the period October 1, 1978 to October 1, 1979. On some data sheets there are blanks or notations indicating incomplete information. A major portion of these data omissions is expected to be retrieved as a result of continued efforts and unavoidable delays. Some data while available has not yet been formally released to the Registry pending further analyses and publication by the personnel of the cooperating facility. Formerly, if no information was given or indicated by health physics as to pre-death chest burden, they were treated as negative and the whole body burden reported as the same as the systemic burden. In the current report this assumption regarding chest burdens has not been made and only the systemic health physics estimates are given.

62123 **(HEHF—32) United States Transuranium Registry annual report October 1, 1979-October 1, 1980 to Human Health and Assessments Division, US Department of Energy.** Breitenstein, B.D. Jr.; Heid, K.R.; Swint, M.J. (Hanford Environmental Health Foundation, Richland, WA (USA)). Jan 1981. Contract AC06-76RL01837. 33p. NTIS, PC A03/MF A01. Order Number DE82015470.

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One of the primary objectives of the United States Transuranium Registry is to improve health physics models used to evaluate occupational exposure from internally deposited transuranic elements. During FY 1980 emphasis continued to be placed on improving methods for collecting data. The use of a prosector for all cases assures that autopsy tissue samples are properly identified and reasonably well cleaned. A procedure has been developed at the University of California Los Alamos Scientific Laboratory to ash tissue specimens collected as part of this program. This same method is also being utilized at the Rocky Flats Analytical laboratory. A comparison of data collected from thirteen USTR autopsy cases using wet and ashed weights was made. The results suggest that the use of ashed weights improves the agreement of the systemic burden at autopsy to that estimated using ante mortem health physics data by a factor of nearly two.

62124 **(HEHF—34) United States Transuranium Registry annual report, October 1, 1980-October 1, 1981 to Human Health and Assessments Division, US Department of Energy.** Breitenstein, B.D. Jr.; Heid, K.R.; Swint, M.J. (Hanford Environmental Health Foundation, Richland, WA (USA)). Jan 1982. Contract AC06-76RL01837. 26p. NTIS, PC A03/MF A01. Order Number DE82015471.

The Registry initiates and supports programs at the various sites, where significant numbers of transuranic workers are employed, to conduct interviews and secure medical, health physics and autopsy releases. Terminated employees, not previously contacted, are encouraged to participate in the Registry program. This effort requires cooperation from the company administration as well as the medical and health physics staff. For those persons who are not reached through this network, we attempt to reach them through information about the Registry in professional newsletters and publications. Table 1 is a summary of the status of the US Transuranium Registry autopsy program as of September 1981. The need to prove or improve the accuracy of the present in vivo

models is of paramount interest to health physicists. The correlation of in vivo measurements with the radiochemical analysis brings the possibilities of increased predictability of whole body deposition closer to reality. The correlation of in vivo with autopsy tissue will aid epidemiological studies to define those observable health effects in the exposed population that should be looked for.

62125 **(INP—1069/PL) Proceedings of the seminar on isochronous cyclotron technique.** (Institute of Nuclear Physics, Krakow (Poland)). 1980. 538p. (CONF-7811203—). NTIS (US Sales Only), PC A23/MF A01. Order Number DE82780744.

From International seminar on isochronous cyclotron technique; Cracow, Poland (13 Nov 1978).

Individual papers are included in the data base. (PSB)

62126 **(LA-UR—82-2460) Soft-x-ray experiment revisited: a theoretical analysis.** Brenner, D.J.; Zaider, M. (Los Alamos National Lab., NM (USA); Columbia Univ., New York (USA). Radiological Research Lab.). 1982. Contract W-7405-ENG-36. 16p. (CONF-820931—2). NTIS, PC A02/MF A01. Order Number DE82021895.

From 8. symposium on microdosimetry; Julich, F.R. Germany (27 Sep 1982).

The generalized formulation of the Theory of Dual Radiation Action (TDRA) deals quantitatively with the process of sublesion-lesion production in sensitive sites irradiated with uniform fields of ionizing radiation. In this paper modifications of this formalism necessary to treat the case of attenuated fields of radiations are described. As an application, recent survival data obtained with soft x-ray experiments are analyzed. It is shown that: (1) given a linear-quadratic dose-effect relation with constant β; (2) the function $\gamma(x)$ can be obtained with the aid of Monte-Carlo generated proximity functions; and (3) this $\gamma(x)$ may be successfully utilized to account for survival results obtained, with the same cell line, using α particles.

62127 **(LBL—13416-Rev.) Epidemiological studies on radiation carcinogenesis in human populations following acute exposure: nuclear explosions and medical radiation.** Fabrikant, J.I. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Donner Lab.; California Univ., San Francisco (USA). Dept. of Radiology). Aug 1982. Contract AC03-76SF00098. 30p. (CONF-8105130—1-Rev.). NTIS, PC A03/MF A01. Order Number DE82022058.

From Symposium on effects on humans of exposure to low levels of ionizing radiation; New Haven, CT, USA (11 May 1981).

The present review provides an understanding of our current knowledge of the carcinogenic effect of low-dose radiation in man, and surveys the epidemiological studies of human populations exposed to nuclear explosions and medical radiation. Discussion centers on the contributions of quantitative epidemiology to present knowledge, the reliability of the dose-incidence data, and those relevant epidemiological studies that provide the most useful information for risk estimation of cancer-induction in man. Reference is made to dose-incidence relationships from laboratory animal experiments where they may obtain for problems and difficulties in extrapolation from data obtained at high doses to low doses, and from animal data to the human situation. The paper describes the methods of application of such epidemiological data for estimation of excess risk of radiation-induced cancer in exposed human populations, and discusses the strengths and limitations of epidemiology in guiding radiation protection philosophy and public health policy.

62128 **(LBL—14772) Carcinogenesis and low-level ionizing radiation with special reference to lung cancer and exposure to radon daughters.** Fabrikant, J.I. (Lawrence Berkeley Lab., CA (USA)). Apr 1982. Contract AC03-76SF00098. 45p. (CONF-820655—9). NTIS, PC A03/MF A01. Order Number DE82022068.

From Health Physics Society annual meeting; Las Vegas, NV, USA (27 Jun 1982).

Of the important health effects of ionizing radiation, three important late effects - carcinogenesis, teratogenesis and mutagenesis are of greatest concern. This is because any exposure, even at low levels, carries some risk of such deleterious effects. As the dose of radiation increases above very low levels, the risk of health effects increases. Cancer-induction is the most important late somatic effect of low-dose ionizing radiation. Solid cancers, rather than leukemia, are principal late effects in exposed individuals. Tissues vary greatly in their susceptibility to radiation carcinogenesis. The most frequently occurring radiation-induced cancers in man include, in decreasing order of susceptibility: the female breast, the thyroid gland, the blood-forming tissues, the lung, certain organs of the gastrointestinal tract, and the bones. A number of biological and physical factors affect the cancer risk, such as age, sex, life-style, LET, and RBE. Despite uncertainty about low-level radiation risks, regulatory and advisory bodies must set standards for exposure, and individuals need information to be able to make informed judgments for themselves. From the point of view of the policy maker, the overriding concern is the fact that small doses of radiation can cause people to have more cancers than would otherwise be expected. While concern for all radiation effects exists, our human experience is limited to cancer-induction in exposed populations. This discussion is limited to cancer risk estimation and decision-making in relation to the health effects on populations of exposure to low levels of ionizing radiation. Here, low-level radiation will refer to yearly whole-body doses up to 5 rems or 0.05 Sv, or to cumulative doses up to 50 rems or 0.5 Sv from low-LET radiation and from high-LET radiation. (ERB)

62129 **(N—82-16704) Clinical distinctions of radiation sickness with exposure of different parts of the human body to radiation.** Nevskaya, G.F.; Abramova, G.M.; Volkova, M.A.; Kavlycheva, Y.V.; Skorik, A.S.; Yurogov, V.V. (Joint Publications Research Service, Arlington, VA (USA)). 12 Jan 1982. 113-118p. (JPRS—79849). NTIS, PC A08/MF A01.

Translated from Kosm. Biol. Aviakosm. Med. (Moscow); 15, No. 6, 77-80(Nov.-Dec. 1981).

The clinical picture of radiation sickness of 139 radiological patients exposed to local irradition of the head, chest, and stomach with efficient doses of 210 rad was examined. It was found that at fractionated local irraditions the clinical symptom-complex of radiation sickness was identifical to that seen as a result of total-body irradiation. During head irradiation the major symptom was headache and during stomach irradiation nausea. The severity level of radiation damage measured with respect to the clinical symptom-complex as a whole with the aid of the bioinformation model was similar during irradiations of the head and stomach, much higher during irradiation of the chest. During head and stomach irradiations the severity level of radiation damage was proportional to the efficient dose. During chest irradiation there was no correlation between the severity level and the exposure to doses of 210 rad.

62130 **(OEFZS—4048) Influence of DNA repair inhibitors on the mutation rate.** Auzinger, T.; Hruby, R. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna). Dec 1980. 14p. (In German). (BL—335/80). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702466.

The simultaneous influence of gamma-radiation and DNA-repair inhibiting substances on the mutation frequency of mice was investigated in vivo with the micronucleus test. The detergens Tween 80, vitamin A, and the antiphlogisticum phenylbutazone were used as DNA-repair inhibiting substances. Using the same irradiation doses, a statistic significant increase of mutagenicity respectively micronucleus frequency was found in high concentrations of Tween 80 and in all used dosages of vitamin A, but not in phenylbutazone and in low concentrations of Tween.

62131 **(TVA—2905135) Report on whole-body counting at nuclear facilities in North America.** Haskins, A.W.; Earls, L.M.; Hudson, C.G. (Tennessee Valley Authority, Knoxville (USA)). Jun 1982. 25p. NTIS, PC A02/MF A01. Order Number DE82905135.

Because of increasing reliance upon whole-body counting for routine monitoring of radiation workers in the nuclear industry, a survey was conducted to determine its current status at nuclear facilities in North America. Information on this subject was obtained by means of confidential questionnaires sent to nuclear power plants, national laboratories, and other nuclear facilities in the United States and Canada, followed up by personal communica-

tions with randomly-selected respondents. A return rate of over 75% of those surveyed indicates strong interest in the exchange of ideas on whole-body counting, an endeavor which appears to have been neglected in the past. Information obtained in this survey was tabulated and several correlations were made which should be of value for improvement and standardization of existing whole-body counting programs as well as those which are in the planning stage. Categories dealt with in this paper include: instrumentation and equipment, data processing, operator training and qualifications, investigation and action levels, and future trends in the philosophy of whole-body counting.

62132 **A real-time kinetic study of luciferase inactivation by pulsed ionizing radiation.** Bell, D.H.; Gould, J.M.; Patterson, L.K. (Univ. of Notre Dame, IN). *Radiation Research;* 90: No. 3, 518-525(Jun 1982).

The real-time kinetics of radiation-induced inactivation of the luminescent firefly luciferase-luciferin system were investigated. A single, microsecond pulse from a Van de Graaff accelerator delivered to the system is sufficient to decrease the luminescence by over 60%. This decrease exhibits exponential behavior and has a half-time of 46 +/- 6 msec. In both steady-state and pulsed studies, the dose dependence of the inactivation is independent of the dose rate. Likewise, the decay kinetics are independent of the dose per pulse. These studies suggest that the enzyme is altered in a way that inteferes with the initial steps of catalysis without affecting the subsequent steps which lead to light emission.

62133 **Inhibition of semiconservative DNA synthesis in ICR 2A frog cells exposed to monochromatic uv wavelengths (252-313 nm) and photoreactivating light.** Rosenstein, B.S. (Univ. of Texas Health Science Center, Dallas). *Radiation Research;* 90: No. 3, 509-517(Jun 1982).

Exposure of ICR 2A frog cells to monochromatic uv wavelengths in the range 252-313 nm caused an inhibition of semiconservative DNA synthesis which was partially relieved in cells receiving a post irradiation treatment with photoreactivating light (>350 nm). Hence pyrimidine dimers acted as lesions blocking DNA synthesis in uv-irradiated cells based upon the specificity of photoreactivating enzyme for the light-dependent monomerization of dimers in DNA. Compared with the shorter wavelengths tested, however, this recovery of DNA synthesis was not as great in cells exposed to 302-nm radiation and was nearly absent in 313-nm-irradiated cells up to 12 hr after treatment. These results suggest that nondimer photoproducts also play an important role in causing DNA synthesis inhibition in cells exposed to wavelengths greater than 300 nm.

62134 **The antiviral effectiveness of butylated hydroxytoluene on herpes cutaneous infections in hairless mice.** Keith, A.D. (Pennsylvania State Univ., University Park); Arruda, D.; Snipes, W.; Frost, P. *Proceedings of the Society for Experimental Biology and Medicine;* 170: No. 2, 237-244(Jun 1982).

Hairless mice, cutaneously infected with herpes simplex virus type 1 (HSV-1), were treated topically with butylated hydroxytoluene (BHT). The effectiveness of BHT in shortening the duration of infections was assayed under three conditions. In the first experiments, mice undergoing primary infections with no prior immunity to HSV-1 were utilized. These animals tended to develop deep lesions that were not typical of recurrent HSV-1 infections in humans. A second set of experiments utilized mice that had recovered from a primary infection and that were immunosuppressed by γ irradiation. Immunosuppression was essential for the full development of lesions upon reinfection. The lesions in these animals remained more localized with less tendency to spread into deep tissues. A third set of experiments utilized animals that were subcutaneously inoculated with human serum γ-globulin 24 hr prior to infection. Lesions on these animals also remained localized and did not penetrate into deep tissues. Under all three conditions, BHT was found to be effective in reducing the clearance time of HSV-1 cutaneous lesions when applied topically to the infected area.

62135 **Effects of ICRP Publication 30 and the 1980 BEIR Report in hazard assessments of high-level waste.** Cohen, B.L. (University of Pittsburgh, PA). *Health Physics;* 42: No. 2, 133-143(Feb 1982).

ICRP Publication 30 (ICRP30) gives the radiation dose to various body organs in Sv per Bq, which are readily translated into rad per curie ingested for various radioisotopes; the 1980 BEIR Report (BEIR III) gives the risk of fatal cancer per rad of dose to each body organ; the ORIGEN 2 Code gives the curies per tonne of initial uranium fuel in high level waste and in spent fuel. The product of these, Ci/tonne x rad/Ci x risk/rad gives the risk/tonne in terms of fatal cancer doses, if ingested, per tonne of uranium. When the resulting curves are compared with those calculated previously (based on ICRP Publication 2 and the 1972 BEIR Report), the hazard is less for the first century but much more thereafter. The principal sources of this greatly increased hazard is the 100-fold increase in absorption through the gut for 237Np in ICRP 30, plus the high cancer risk from radiation to liver in BEIR III. Some consequences of these changes and some scientific questions relevant to ascertaining their validity are discussed.

62136 **Quantification of mammalian sperm morphology by slit-scan flow cytometry.** Benaron, D.A.; Gray, J.W.; Gledhill, B.L.; Lake, S.; Wyrobek, A.J.; Young, I.T. (Lawrence Livermore National Lab., CA). *Cytometry (Baltimore);* 2: No. 5, 344-349(1982). Contract W-7405-ENG-48.

The head shapes of mammalian sperm were measured by slit-scan flow cytometry (SSFCM). Fluorescence profiles were measured for sperm from mice, rabbits, hamsters, and bulls, and for sperm from mice, rabbits, hamsters, and bulls, and for sperm from mice exposed to testicular x-irradiation from 0 to 900 rads. Some of the fluorescence profiles for sperm from the irradiated mice differed significantly from the profiles usually measured for sperm from unexposed mice. An algorithm was developed to determine the frequency of these sperm. The estimated frequencies of atypical profiles correlated well with the frequencies of abnormally shaped sperm determined by microscopic scoring. The maximum SSFCM sensitivity was not as high as that for the visual assay. However, only 100 profiles were measured by SSFCM at each dose while at least 500 sperm were scored visually at each dose. The sensitivity of the SSFCM assay should be increased substantially by measuring more profiles. The objective nature of SSFCM coupled with the high correlation with results from the visually based assay of morphology suggests the use of SSFCM to measure frequencies of misshapen sperm when testing for mutagens or monitoring for effects of environmental contaminants.

62137 **Induction of chromosome damage by ultraviolet light and caffeine: correlation of cytogenetic evaluation and flow karyotype.** Cremer, C.; Cremer, T.; Gray, J.W. (Lawrence Livermore National Lab., CA). *Cytometry (Baltimore);* 2: No. 5, 287-290(1982). Contract W-7405-ENG-48.

Asynchronously growing cells of a M3-1 Chinese hamster line were ultraviolet (uv) irradiated (λ = 254 nm) with uv fluences up to 7.5 J/m^2. After irradiation, cells were incubated with or without 2 mM caffeine for 20 hr, then mitotic cells were selected by mechanical shaking. Their chromosomes were isolated, stained with Hoechst 33258 and chromomycin A3, and measured flow cytometrically. While the fluorescence distributions of chromosomes (flow karyotypes) from cells treated with uv alone or with caffeine alone were very similar to those of untreated controls, the flow karyotypes of uv + caffeine-treated cells showed a debris continuum that increased with increasing uv fluence suggesting an increased number of chromosome fragments. Visual evaluation of metaphase plates revealed that the percentage of cells with chromosome damage also increased steadily with increasing uv fluence. A high degree of correlation was observed between the relative magnitude of the debris level from flow karyotypes and the percentage of cells with chromosome damage and with generalized chromosome shattering, respectively, as determined from metaphase spreads.

62138 **(JPRS—79849) USSR report: Space Biology and Aerospace Medicine, Volume 15, No. 6, November-December 1981.** Translated from *Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina ;* 15: No. 6, vp(Nov-Dec 1981). 154p. NTIS, PC A08/MF A01.

Articles are presented which address life support systems human and animal physiological responses to spacecraft environ-

ments, radiation and weightlessness and flight fatigue in helicopter crews. For individual titles, see N82-16705 through N82-16730.

62139 **Taetigkeitsbericht 1980 bundesgesundheitsamt. (1980 activity report of the German Federal Republic's Public Health Administration).** Berlin, Germany; Dietrich Reimer Verlag (1980). 239p. (NP—2903385). Dietrich Reimer Verlag, Unter den Eichen 57, 1000 Berlin 45.

The department's activities are categorized into the areas of pharmacology, toxicology, environmental hygiene, radiation safety standards, prevention and treatment. Information is also given on scientific conferences, administration, management, personnel, construction and planning as well as an enumeration of cooperating institutes. Information is also given on scientific publications and dissertations resulting from research undertaken within the Health Department's institutes or cooperating organizations.

62140 **Biological risks of medical irradiations.** Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980). 344p. (CONF-8003106—). American Institute of Physics, 335 East 45 Street, New York, NY 10017 $21.00.

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

The articles in this book were presented at a three-day symposium designed for the continuing education of medical physicists and radiologists. The objectives were: (1) to update understanding of radiation risks, particularly with respect to cancer induction, possible effects on future generations, and risks to the child irradiated during gestation; (2) to present information on radiation dose estimation from medical procedures; (3) to review methods for reducing radiation risks; and (4) to present an overview of the laws and regulations concerning the administration of radiation to the patient, including the potential for litigation. Separate abstracts have been prepared for each article for inclusion in the Energy Data Base. (RJC)

62141 **Basis for estimating the risks of low-level radiation.** Bond, V.P. (Brookhaven National Lab., Upton, NY). pp 21-32 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

A model is described which provides a logical, operational framework in which to consider mutagenesis and carcinogenesis related to low-level radiation exposure in man. (RJC)

62142 **Irradiation damage to the embryo, fetus, and neonate.** Russell, L.B. (Oak Ridge National Lab., TN). pp 33-54 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

Radiation during preimplantation stages probably produces no abnormalities in survivors, owing to the great developmental plasticity of very early mammalian embryos. Radiation at later stages may, however, produce morphologic abnormalities, general or local growth retardation, or functional impairments if doses are sufficient. Obvious malformations are particularly associated with irradiation during the period of major organogenesis which in man extends approximately from week two through week nine after conception. More restricted morphologic and functional abnormalities and growth retardations dominate the spectrum of radiation effects produced during the fetal and early post-natal periods. Some of these effects can be apparent at birth and others may show up later; subtle functional damage cannot be adequately measured with available techniques. Because the central nervous system is formed during a relatively long period in human development, such abnormalities as microcephaly and mental retardation figure prominently among the list of radiation effects reported in man. Animal data indicate that readily measurable damage can be caused by doses well below 10 R of acute irradiation applied at stages that are sensitive to specific effects being studied (CNS injury and oocyte-killing).

62143 **Estimates of cancer risks from low-level exposure to ionizing radiation: the BEIR Report 1980.** Webster, E.W. (Massachusetts General Hospital, Boston). pp 55-77 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

This paper summarizes the significant conclusions of the National Academy of Sciences 1980 report on the carcinogenic effects of low levels of ionizing radiation. The dearth of epidemiological data on the effects of doses in the range 1 to 20 rads make it necessary to assume a theoretical relation between radiation dose and the likelihood of cancer induction, so that predictions of low-dose effects can be made on the basis of relatively well-defined high-dose observations in man. The BEIR Committee has been guided by radiobiological data on cellular and animal effects and by the statistically weak data on human cancer induction by low doses, primarily the Japanese A-bomb survivor data, to derive an envelope of risk estimates based on three dose/effect relations. Employment of a linear-quadratic relation derived from cancer mortality of the survivors in the period of 1950-74 has provided the basis for the preferred set of risk estimates for whole-body exposure to low LET radiation. No allowance has been made for dose-rate effects. The best estimate of increased cancer mortality risk for 1 rad/year of whole-body low LET radiation received between ages 20 and 65 is about 2% of the normal expectation of death from cancer. The increase in the risk of cancer occurrence is similar. For estimating risks from partial body exposure to specific internal organs, the predominance of high-dose data has led to the adoption by default of a linear dose/effect relation except for leukemia and bone cancer. The continuing uncertainty regarding increased sensitivity of the fetus to the carcinogenic effects of radiation is noted. The report expresses skepticism regarding several recent claims of increased cancer in limited populations exposed to doses of the order of 1 rad.

62144 **Update on the UNSCEAR report.** Mettler, F.A. Jr. (Univ. of New Mexico, Albuquerque). pp 78-91 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

The UNSCEAR Committee plans to expand the 1977 report by inclusion of pertinent data generated since the previous report. To date there appears to be little justification for changing genetic risk estimates; the linear-quadratic dose response function appears satisfactory for low-LET radiation; the non-stochastic effects of low dose radiation will be carefully examined. Additionally, the Committee feels that life-shortening in most animal species and in humans is probably the result of induction of malignant neoplasms. Medical radiation will be considered in terms of describing somatic detriment and essentially using the model described by the ICRP.

62145 **Dose evaluation in diagnostic radiology.** Bushong, S.C. (Baylor College of Medicine, Houston, TX). pp 105-124 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

The evaluation of radiation doses received in diagnostic x-ray procedures are discussed in this article under the following headings: radiation quantities and units; dose modifying factors; specification of patient dose; current clinical situations; and occupational exposure. (RJC)

62146 **Dose evaluation in nuclear medicine.** Kereiakes, J.G.; Thomas, S.R.; Gelfand, M.J.; Maxon, H.R.; Saenger, E.L. (Univ. of Cincinnati, OH). pp 125-153 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

This presentation provides available information on various parameters involved in estimating the radiation doses in clinical nuclear medicine. The most commonly applied radionuclides are discussed. Of special interest is the estimation of absorbed doses to several pediatric age groups and to the embryo and fetus. Physiological and physical considerations are described. (RJC)

62147 **Risk/benefit considerations in radiology.** Gregg, E.C. (Case Western Reserve Univ., Cleveland, OH). pp 160-176 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

Consideration is given of the basic radiobiologic effects of ionizing radiations in estimating risks and benefits resulting from the medical uses of such radiations. Even though worst case conditions are assumed, such as a linear non-threshold dose-effect relationship, the genetic and somatic risks for the doses usually encountered in medicine appear quite minimal relative to other environmental agents. Data are presented and analyzed regarding the impact of these considerations on the individual, society, occupationally engaged personnel and accelerator design.

62148 **Methods of risk reduction in diagnostic radiology.** Bushong, S.C. (Baylor College of Medicine, Houston, TX). pp 177-192 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

Administrative procedures and technical devices employed in reducing radiation exposure to patients and personnel without affecting diagnostic information are described under the following headings: patient protective methods; radiographic technique charts; x-ray beam limitation; selection process; personnel protective measures; barrier shields; protective apparel; and administration procedures. (RJC)

62149 **Methods of risk reduction in nuclear medicine.** Kereiakes, J.G.; Thomas, S.R.; Saenger, E.L. (Univ. of Cincinnati College of Medicine, OH). pp 193-215 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

Two aspects of radiation protection in nuclear medicine are discussed: patients receiving radionuclides for diagnostic or therapeutic purposes; and persons exposed to radiation by being close to patients containing radionuclides. General recommendations regarding new procedures, instruments, and radiopharmaceuticals to ensure minimum radiation dose to adult, pediatric, and pregnant women patients are included. (RJC)

62150 **Method of risk reduction in radiation therapy.** Shalek, R.J. (Univ. of Texas System Cancer Center, Houston). pp 216-222 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

Reduction of risk to the patient undergoing radiotherapy is discussed in this paper. It is generally accepted that radiation tumor doses delivered should be within 5% of that prescribed. It is also generally taken that no harm will come to a patient if the dose to a particular organ is within 10% of that considered tolerable. I was aware of that statement 30 years ago and I assume that it has an even longer history. There are suggestions from time to time that both of these criteria are too wide. With modern measuring instruments, diagnostic methods and calculation techniques, it is possible to reduce the tumor dose criteria to 4% and perhaps to 3%. There is also some clinical data which suggests that local tumor control may depend upon very precise delivery of radiation dose. Shukovsky has published data indicated that local control of squamous carcinoma of the supraglottic larynx may depend sharply upon dose differences as small as 5%. Thus we are in a time of tightening dose standards which may have justification in clinical findings.

62151 **Radiation teratogenesis: fetal risk and abortion.** Brent, R.I. (Thomas Jefferson Univ., Philadelphia, PA). pp 223-252 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

The effects of radiation on the developing mammalian embryo and especially the human embryo are reviewed. Counseling the women of reproductive age who will be exposed to radiation or have been exposed to radiation is frequently performed by physicians in a cavalies fashion, without the benefit of knowing the radiation exposure or the risks. The patient should be made aware of the radiation hazards to the embryos by individuals who are knowledgeable. Human radiation teratogenesis is described.

62152 **Radiation risk education program - local.** Bushong, S.C.; Archer, B.R. (Baylor College of Medicine, Houston, TX). pp 253-266 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

This article points out the lack of knowledge by the general public and medical profession concerning the true risks of radiation exposure. The author describes an educational program which can be implemented at the local level to overcome this deficiency. The public must understand the enormous extent of benefit derived from radiation applications in our society. (RJC)

62153 **Radiation risk education program - national.** Properzio, W.S. (Bureau of Radiological Health, Rockville, MD). pp 267-274 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

The importance of understanding both the risks as well as the benefits derived from radiological diagnostic techniques is discussed. There is a need for an educational program which can be implemented at the national level to aid in public understanding and attitudes toward nuclear medicine. Several user education programs are described. (RJC)

62154 **Liability for radiation exposure from the viewpoint of the practitioner.** Collins, V.P. pp 300-308 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

A mounting concern for environmental radiation hazards spills over into an increasing fear and mistrust of medical uses of radiation. This situation sets the stage for an increasing recourse to litigation particularly in the area of low level radiation exposure. Knowledge that the initial exposure is unfelt, that the injury may be long-delayed in appearance, and that the injury is nonspecific, only feeds the apprehension of the public. Over centuries of experience, courts have evolved rules of law for the decision-making process that call for definitions of proof and truth that differ from those of science. A series of legal cases involving radiation injuries are presented to demonstrate the evolution of applicable legal mechanisms. The earliest cases leaned to strict application of the elements of negligence, proof of injury, causation and fault. These requirements relaxed gradually to minimize the burden of proof of the injured plaintiff. Elements of anxiety were recognized as compensable. A requirement of informed consent replaced a need to prove negligence. The element of fault, becoming increasingly difficult to prove with the complexity of delayed effects and statistics of probability, is dropped in the doctrine of product liability or strict liability. This may be a necessary solution to allow compensation of an

innocent injured party where fault may be impossible to prove and where, in fact, it may not exist.

62155 **Analysis of the physician's professional liability for irradiation of the fetus.** Perdue, J.M. (Perdue, Turner and Berry, Attorneys at Law, Houston, TX). pp 309-320 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

An evaluation of professional liability in the utilization of x-rays on a female patient of childbearing age is discussed. An analysis of the present law on x-ray injury to the fetus is presented. Some cases of interest are summarized. (RJC)

62156 **Liability from the view of the medical physicist.** Shalek, R.J. (Univ. of Texas System Cancer Center, Houston). pp 321-328 of Biological risks of medical irradiations. Fullerton, G.D.; Kopp, D.T.; Waggener, R.G.; Webster, E.W. (eds.). New York, NY; American Institute of Physics (1980).

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

The negligent performance of professional duties is the most probable type of legal action against a medical physicist. A mistake resulting from ignorance or inadvertence is an example; an error in professional judgement is not negligence if an ordinary, prudent physicist in the same situation would have made the same decision. A physicist or any hospital employee has a duty to protect his employer from liability even to the extent of reporting to the hospital medical practices which could harm the patient. Suggestions for reducing legal risk include recommendations for professional knowledge, record keeping and outside verification of important elements of operating systems.

62157 **Taetigkeitsbericht 1979 bundesgesundheitsamt. (1979 activity report of the German Federal Republic's Public Health Administration).** Berlin, Germany; Dietrich Reimer Verlag (1979). 238p. (NP—2902554). Dietrich Reimer Verlag, Unter den Eichen 57, 1000 Berlin 45.

Portions of document are illegible.

Information is presented on activities undertaken by various research and clinical institutes of the German Federal Republic's Health Department in the areas of pharmacology, public health protection, environmental hygiene, radiation sanitation, prevention and treatment of diseases. Information is also offered on tasks, personnel, construction projects, information and documentation systems, and departmental administration.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 62055

62158 **Body temperatures and behavior of American alligators during cold winter weather.** Brisbin, I.L., Jr.; Standora, E.A.; Vargo, M.J. *American Midland Naturalist;* **107**: No. 2, 209-218(Apr 1982).

Data from two large (188 and 135 kg) male alligators (Alligator mississippiensis) indicated that 4-5 C seemed to be the lowest body temperatures that they could endure with subsequent recovery. Although one animal in shallow water managed to keep a breathing hole open for several days, in ice that was 1.5 cm thick, it later died following a decrease of its body temperature to 4.0 C. The second alligator which was located in a deeper portion of the reservoir used both terrestrial and aquatic basking behavior to raise its body temperature and level of activity. Except in the case of basking events, there was not clear evidence of significant evaluations of the body temperatures of either the live or dead alligators above those of their adjacent water. When located side-by-side, diurnal cycles of deep body temperatures exceeding adjacent water temperatures to a maximum extent near dawn and usually falling below water temperatures during the afternoon and early evening hours. The physical properties and thermal inertia of the bodies of such large alligators, when placed in appropriate microclimates, may be sufficient in themselves to explain the general patterns and levels of body temperature changes observed at these low temperatures.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 60844, 60900, 60902, 60903, 60909, 60910, 60911, 61994, 61996, 62047, 62097

62159 (CONF-8106214—, pp 439-457) **Intricate measure: an agricultural perspective on research tools for early detection of the biological, biochemical, and environmental sensitivities to CO_2.** Wittwer, S.H. (Michigan State Univ., East Lansing). 1981. NTIS, PC A24/MF A01.

From Conference on the first detection of carbon dioxide effects; Harpers Ferry, WV, USA (8 Jun 1981).

A uniquely different approach is presented for the first detection or the intricate measure of small increments of atmospheric CO_2. The focus is first on responses of economically important parts of the biosphere with respect to the already demonstrated most sensitive effects on the biological processes or phenomena that control growth and productivity (photosynthesis, biological nitrogen fixation, harvest index, tuberization, nodulation of legumes, water requirements transpiration, stomatal behavior, initial products of [^{14}C] CO_2 fixation, and shifts in these amounts of the products). Here the primary effort will be with selected species of C_3 plants. They are the ones that respond most dramatically to elevated levels of atmospheric CO_2. Included is a review of possible intricate measures of small increments in atmospheric levels of CO_2 relative to alterations in the biochemistry of CO_2 assimilation. Secondly, attention is given to first detection by intricate measure of temperature-sensitive biological phenomena [growing degree days or thermal units for maturity, dry matter increases in aquatic species and hybrid forest tree species, pest (insect and nematode) migrations, plant disease infestations]. These surrogate indicators of first detection can be useful if they clearly and quickly reflect a climate change ascribable to an increase in atmospheric CO_2. Research suggestions are discussed. A search for first detection suggests two possibilities: determine the sensitivity of stomatal behavior with small increments of atmospheric CO_2, and measure changes in infestivity of pathogens that must penetrate stomata.

62160 **(DOE/EV/01668—130) Mechanisms of calcium transport in small intestine. Final report.** DeLuca, H.F. (Wisconsin Univ., Madison (USA). Dept. of Biochemistry). 1 Jul 1982. Contract AC02-76EV01668. 4p. NTIS, PC A02/MF A01. Order Number DE82021528.

The vitamin D hormone, 1,25-dihydroxyvitamin D_3, was demonstrated to be the prime hormonal agent regulating intestinal absorption of divalent cations. Production of the vitamin D hormone is, in turn, regulated by parathyroid hormone, low dietary calcium, low plasma phosphorus, and is suppressed by 1,25-dihydroxyvitamin D_3, by high plasma phosphorus, high plasma calcium, and the absence of parathyroid hormone. A variety of analogs of the vitamin D hormone were prepared. In addition, the preparation of radiolabeled vitamin D hormone was accomplished using chemical synthesis, and this highly radioactive substance was found to localize in the nuclei of the intestinal villus cells that promote intestinal absorption of calcium. A receptor for the vitamin D hormone was also located, and the general mechanism of response to the vitamin D hormone included the binding to a receptor molecule, transfer to the nucleus, transcription of specific genes followed by translation to transport proteins. Methods were developed for the discovery of the appropriate gene products that play a role in calcium transport.

62161 **(DOE/EV/03972—T2) Development of integrated in vivo/in vitro system for the study of carcinogenic effects of energy-related by-products. Progress report No. 2, November 1, 1978-October 31, 1979.** Yuhas, J.M. (New Mexico Univ., Albuquerque (USA). Dept. of Radiology). 1979. Contract AS04-77EV03972. 30p. NTIS (US Sales Only). Order Number DE82015013.

Portions of document are illegible.

Progress is reported in the following areas of research: development of a means of isolating type II cells from the mouse lung

in a reproductively intact condition; growth of these cells in monolayer culture; serial propagation of these cells; production of transformants in vitro by the addition of carcinogens to the cultures; induction of transformation in vivo followed by assay in vitro; verification of the tumorgenic potential of the transformants by analysis of their quantitative and qualitative characteristics; quantitation of the in vivo and in vitro transformation process; and comparison of the quantitative aspects of the two systems with each other and with in vivo tumor yield patterns. Research in the first four areas was extended during the past year to include human lung cells, and on a limited scale, to include in vitro analysis of ^{131}I radiation carcinogenesis in thyroid cultures. (ERB)

62162 **(DOE/EV/04331—08) Air pollution effects on food quality. Final progress report.** Pell, E.J. (Pennsylvania State Univ., University Park (USA). Center for Air Environment Studies). Aug 1982. Contract AC02-77EV04331. 52p. (COO—4331-08). NTIS, PC A04/MF A01. Order Number DE82021593.

This project studied the potential of ozone (O_3) or nitrogen dioxide (NO_2) to alter the quality of potato and alfalfa. Three studies are summarized.

62163 **(DOE/EV/04659—T1) Progress report, July 1981-July 1982.** McCormick, J.J.; Maher, V.M. (Michigan State Univ., East Lansing (USA)). 1982. Contract AC02-78EV04659. 19p. NTIS, PC A02/MF A01. Order Number DE82021527.

Research progress is reported for the period July 1981 through July 1982. Two reactive metabolites of benzo(a)pyrene were compared to determine whether in diploid human fibroblasts, one is more mutagenic than the other and their action compared in diploid Chinese hamster fibroblasts. The mutagenic action of a model compound for aflatoxin was determined in repair-proficient and repair-deficient human cells as an example of a compound similar to benzo(a)pyrene in structure but different in binding to DNA and in mechanism of mutagenesis. It was determined whether diploid human endothelial or epithelial cells can be induced to transform into anchorage independent cells using chemical carcinogens and/or radiation and whether these cell types share steps to tumorigenicity in common with diploid human fibroblasts. (ACR)

62164 **(DOE/EV/10117—T1-Vol.1) Identification of hazards in non-nuclear power plants. Phase I and Phase II. Summary report.** (NUS Corp., Rockville, MD (USA)). Aug 1979. Contract FG03-78EV10117. 34p. NTIS, PC A03/MF A01. Order Number DE82021526.

Portions of document are illegible.

Work performed in the first step of an evaluation of the public health and safety hazards associated with non-nuclear plants is reported. This study was limited to hazards which could affect the general public outside the plant boundaries. Public health and safety hazards were identified for seven types of power plants: coal-fired conventional boiler, atmospheric fluidized bed boiler, pressurized fluidized bed-combined cycle, oil-fired, oil-fired steam turbine, combined cycle, combustion (gas) turbine, and geothermal. Major plant systems effecting the hazards were identified and are described. Potentially hazardous conditions and events were identified for normal and abnormal plant operating conditions and for accidents at the plant. A classification of each hazard was made which identifies the initiating event, the hazard source, equipment or conditions that increase, monitor or mitigate the hazard. An event tree was developed for each plant which relates the effect on the general public for each hazard and initiating event. A semi-quantitative hazard ranking was developed that provides a method of comparing the hazards and events at different types of plants. Consideration was given to the sensitivity of the hazard ranking to population density, changes in operating mode and technology changes.

62165 **(DOE/EV/10117—T1-Vol.2) Identification of hazards in non-nuclear power plants. Volume II. Phase II.** Fell, R.W. (NUS Corp., Rockville, MD (USA)). Aug 1979. Contract FG03-78EV10117. 128p. NTIS, PC A07/MF A01. Order Number DE82021584.

Portions of document are illegible.

This study extends the Phase I study to also include a hazards evaluation for two new emerging coal power plant technologies: coal fired atmospheric fluidized bed and pressurized fluidized bed power generating systems. The study also considers the sensitivity of the hazards ranking for all the non-nuclear power plants to the effects of population density, mode of plant operation, technical changes, location and environmental (temperature) effects. Information is provided under the following section headings: background; environmental and public health concerns associated with fluidized-bed combustion power plants; description of a conceptual atmospheric fluidized-bed power plant; pressurized fluidized-bed combustion combined cycle (PFBCC) power plant; hazard ranking and risk assessment for non-nuclear power plants; and, hazards sensitivity analysis.

62166 **Contact-stimulated proliferation of cultured mouse epidermal cells by 3T3 feeder layers: inhibition of proliferation by 12-O-tetradecanoylphorbol-13-acetate (TPA).** Miller, D.R. (Univ. of Tennessee, Oak Ridge); Hamby, K.M.; Slaga, T.J. *Journal of Cellular Physiology;* **112**: No. 1, 76-82(Jul 1982). Contract W-7405-ENG-26.

Mouse epidermal cells can be subcultured at 31°C onto an irradiated BALB/c 3T3 clone A31 feeder layer. A31 cells (supposedly derived from embryonic fibroblasts) were found to be specifically required for the optimal production of keratinizing epidermal colonies in secondary culture. This effect was not transmitted through the medium nor by the culture surface, since A31 cells plated on one end of a flask did not stimulate epidermal cell proliferation at the other end, even if the other end had previously held A31 cells. Epidermal cell contact with metabolizing A31 cells was probably necessary for the effect; fixed or freeze-thawed A31 cells were ineffective. The tumor promoter 12-O-tetradecanoylphorbol-13-acetate, recently shown to interfere with contact-mediated transfer of label (metabolic cooperation) between Swiss 3T3 cells and cells of an established epidermal line in vitro, also blocked epidermal colony formation. The A31-epidermal cell interaction is apparently not a typical mesenchymal-epithelial interaction, since the basement membrane would prevent this contact in intact skin.

62167 **Micronutrients and kelp cultures: evidence for cobalt and manganese deficiency in southern California deep seawater.** Kuwabara, J.S. (California Inst. of Tech., Pasadena). *Science (Washington, D.C.);* **26**: 1219-1221(11 Jun 1982). Contract AC03-76ET20000.

It has been suggested that naturally occurring copper and zinc concentrations in deep seawater are toxic to marine organisms when the free ion forms are overabundant. The effects of micronutrients in the growth of gametophytes of the ecologically and commercially significant giant kelp (Macrocystis pyrifera) were studied in defined media. The results indicate that toxic copper and zinc ion concentrations as well as cobalt and manganese deficiencies may be among the factors controlling the growth of marine organisms in nature.

62168 **Activation of immune complement by fly ash particles from coal combustion.** Hill, J.O.; Rothenberg, S.J.; Kanapilly, G.M.; Hanson, R.L.; Scott, B.R. (Lovelase Biomedical and Environmental Research Inst., Albuquerque, NM). *Environmental Research;* **28**: No. 1, 113-122(Jun 1982). Contract AC04-76EV01013.

The interaction of immune complement with fly ash particles from coal combustion was studied in vitro. Fly ash from different coal combustors was incubated for 1 hr with pooled normal dog serum at 37°C. The serum supernatants were assayed for complement by a 505 hemolytic (CH_{50}) endpoint method. Ash produced by burning one type of coal activated complement with up to 70% of the complement activated at 10 mg ash/ml serum. This activation was concentration dependent and a linear dose-response curve was obtained. Heat treatment and surface area measurements, as well as immunofluorescence studies, suggest that the active component(s) is volatile or heat labile, found on the surface of the particles, and removed by saline or water extraction.

62169 **Controlled-delivered vapor generator for animal exposures.** Decker, J.R.; Moss, O.R.; Kay, B.L. (Pacific Northwest Lab., Richland, WA). *American Industrial Hygiene Association Journal;* **43**: No. 6, 400-410(Jun 1982).

A vapor generation system is described which provides long-term stable vapor concentrations for inhalation bioassay tests with laboratory animals. Liquid is pumped from a reservoir by a micrometering pump to the surface of a cylindrical vaporizer covered with a glass fiber wick. An 80-watt heater and temperature sensor, embedded in the cylinder, control the vaporizer temperature. Pump rates of 0.01 to 20 mL/min and surface temperatures greater than 100° C can be achieved. To minimize condensation on delivery-tube walls, the vaporizer is positioned in the dilution air inlet tube leading directly into the 2-m^3 exposure chamber. During exposure of rats, mice and rabbits to eleven different chemicals for periods ranging from 4 hours to over 400 daily 6-hour exposure periods, concentrations from 25 to 10,000 ppm were achieved with a dilution air flow of 280 L/min. Chamber concentrations were routinely maintained within 10% of target levels. Stable pump rates provide a method of calculating vapor concentration independent of chemical analysis. Long-term generation stability and ease of operation reduce labor requirements compared to previous generation techniques.

62170 **Immunoreactive somatostatin and β-endorphin content in the brain of mature rats after neonatal exposure to propylthiouracil.** Kato, N. (Univ. of Manitoba, Winnipeg, Canada); Sundmark, V.C.; Van Middlesworth, L.; Havlicek, V.; Friesen, H.G. *Endocrinology;* **110**: No. 6, 1851-1855(Jun 1982).

The contents of immunoreactive somatostatin (IR-SRIF) and β-endorphin (IR-β-EP) in 12 brain regions were examined in rats exposed neonatally to propylthiouracil (PTU) through the mother's milk. Since the dose of PTU used in the study is lower than the usual dose employed to induce hypothyroidism, a milder form of neonatal hypothyroidism resulted. This conclusion is supported by the only mild subnormal growth of rats to adulthood and serum T_4 and T_3 concentrations in the normal range. Adult rats treated with PTU neonatally had significantly higher IR-SRIF contents in several brain regions compared to controls, whereas IR-β-EP levels were not significantly different (significant increase only in the thalamus) in most regions. The results indicate that even mild hypothyroidism during early postnatal development causes permanent impairment of brain function, which manifests itself in part by an altered brain content of IR-SRIF.

62171 **Biliary lipids, bile acids, and gallbladder function in the human female:effects of contraceptive steroids.** Kern, F., Jr. (Univ. of Colorado, Denver); Everson, G.T.; DeMark, B.; McKinley, C.; Showalter, R.; Braverman, D.Z.; Szczepanik-Van Leeuwen, P.; Klein, P.D. *Journal of Laboratory and Clinical Medicine;* **99**: No. 6, 798-805(Jun 1982). Contract W-31-109-ENG-38.

Reported are biliary lipid composition and secretion, bile acid composition and kinetics, and gallbladder function in a group of healthy, nonobese women taking a contraceptive steroid preparation. A comparable group of healthy women served as controls. Biliary lipid secretion rate was measured by the marker perfusion technique. Bile acid distribution was determined by gas-lipid chromatography. The pool size, FTR, and synthesis rate of each bile acid were measured by using CA and CDCA labeled with the stable isotope of carbon, ^{13}C. In some of the subjects gallbladder storage and emptying were measured during the kinetic study, by real-time ultrasonography. Contraceptive steroid use was associated with a significant increase in biliary cholesterol saturation and in the lithogenic index of bile. The rate of cholesterol secretion in the contraceptive steroid group was 50% greater than in the control ($p << 0.001$) and the rate of bile acid secretion was reduced ($p < 0.02$). The total bile acid pool size was significantly increased by contraceptive steroids. The major increase occurred in the CA pool ($p < 0.04$). The daily rate of enterohepatic cycles of the bile acid pool was decreased by contraceptive steroids from 6.6 to 4.3 ($p < 0.01$). The only effect of contraceptive steroids on gallbladder function was a slower emptying rate in response to intraduodenal amino acid infusion. No index of gallbladder function correlated significantly with any parameter of bile acid kinetics in this small group of subjects. The findings confirm the lithogenic effect of contraceptive steroids and indicate that its causes are an increase in cholesterol secretion and a decrease in bile acid secretion.

62172 **Effects of acid on plant litter decomposition in an arctic lake.** McKinley, V.L.; Vestal, J.R. (Univ. of Cincinnati, OH). *Applied and Environmental Microbiology;* **43**: No. 5, 1188-1195(May 1982).

The effects of acid on the microbial decomposition of the dominant aquatic macrophyte (Carex sp.) in Toolik Lake, Alaska were studied in microcosms during the ice-free season of 1980. Toolik Lake is slightly buffered, deep, and very oligotrophic. Microbial activities, as determined by ^{14}C-acetate incorporation into extractable lipids, associated with Carex litter were signficantly ($P < 0.01$) reduced within 2 days at pHs of 3.0 and 4.0, but not 5.0, 5.5 or 6.0, as compared with ambient controls (pH 7.4). ATP levels were signficantly reduced at pH 3.0 but not at the other pHs tested. After 18 days, microbial activity signficantly correlated with weight loss ($P < 0.05$), nitrogen content ($P < 0.01$), and C/N ratios ($P < 0.01$) of the liter, but did not correlate with ATP levels. Scanning electron microscopy of the litter surface revealed that the fungi present at ambient pH did not become domimant at pHs below 5.5, diatoms were absent below pH 4.0, and bacterial numbers and extracellular slime were greatly reduced at pH 4.0 and below. Mineralization of Carex ^{14}C-lignin-labeled or ^{14}C-cellulose-labeled ligno-cellulose was reduced at pH 2.0, but not at pH 4.0, 5.0, or 6.0, compared with controls (pH '). We concluded that if the pH of the water from this slightly buffered lake was sufficiently reduced, rates of litter decomposition would be significantly reduced.

62173 **Effects of chronic air pollution stress on photosynthesis, carbon allocation, and growth of white pine trees.** McLaughlin, S.B.; McConathy, R.K.; Duvick, D.; Mann, L.K. (Oak Ridge National Lab., TN). *Forest Science;* **28**: No. 1, 60-70(Mar 1982). Contract W-7405-ENG-26.

Comparisons of annual growth, photosynthetic capacity, and fate of photosynthetic products were made to determine the rate and case of declining vigor of oxidant-stressed white pine (Pinus strobus L.) growing near Oak Ridge, Tennessee. Three approximately 25-year-old trees were selected for study from each of three sensitivity classes based on needle color, length, and duration of retention. Growth ring analysis revealed comparable growth trends in intermediate and tolerant trees whereas sensitive trees experienced a steady decline in average ring width (70 percent decrease over 15 years) and a loss in capacity for recovery of growth. The fate of photosynthetically fixed ^{14}C was followed after supplying $^{14}CO_2$ to in situ foliage four times (June, July, August, November) during the growing season. Carbon-14 transport patterns emphasized the role of older needles as sources of photosynthate for new needle growth in spring and storage sinks in the fall. Higher retention of ^{14}C-photosynthate by foliage and branches of sensitive trees indicatd that photosynthante export to boles and roots was reduced. Photosynthetic capacity (CO_2 uptake/g dwt) of foliage of sensitive and tolerant trees was similar. The ratio of respiratory to photosynthetic activity was significantly higher for foliage of sensitive trees. Results suggest that declining vigor of sensitive trees in ths area results from reductions in needle longevity, size, increased respiratory activity, and altered translocation patterns which are induced by chronic air pollution stress.

62174 **Toxicity of Santa Barbara seep oil to starfish embryos. Part 3. Influence of parental exposure and the effects of other crude oils.** Spies, R.B.; Davis, P.H. (Lawrence Livermore National Lab., CA). *Marine Environmental Research;* **6**: 3-11(1982). Contract W-7405-ENG-48.

Researchers exposed the bat starfish, Patiria miniata, to the water-soluble fraction (WSF) of oil from a natural seep near Santa Barbara, California, during the first 48 hours of embryological growth. There were no consistent differences among populations whose parents were from areas with differing levels of hydrocarbon exposure. In a second experiment, the order of decreasing toxicity of crude oils to the embryos was: Monterey Zone > Rincon Zone > Prudhoe Bay > Isla Vista Seep. The results are discussed in relation to the effects of natural seeps and oil characteristics.

62175 **Mutation induction in Haemophilus influenzae by ICR-191 II. Role of DNA replication and repair.** Kimball, R.F.; Perdue, S.W. (Oak Ridge National Lab., TN). *Mutation Research;* **80**: 249-258(1981). Contract W-7405-ENG-26.

Evidence is presented to show that presumptive frameshift mutations induced in Haemophilus influenzae by ICR-191 are fixed very repidly, essentially at the time of treatment. DNA synthesis during treatment is essential for fixation, but DNA synthesis after treatment has no effect. The conclusion is drawn that the mutagen acts at the replication fork, possibly to stabilize misannealings arising in association with the discontinuities in the newly synthesized DNA. (JMT)

62176 **Use of nitrous acid-dependent decrease in mutagenicity as an indication of the presence of mutagenic primary aromatic amines: non-specific reactions with phenols and benzo[a]pyrene.** Haugen, D.A.; Peak, M.J.; Reilly, C.A., Jr. (Argonne National Lab., IL). *Mutation Research;* **82**: 59-67(1981). Contract W-31-109-ENG-38.

Some factors concerning the validity of using decreases in mutagenicity due to nitrous acid treatment as an indication of the presence of mutagenic primary aromatic amines in complex mixtures were examined. It was found that treatment of benzo[a]pyrene with nitrous acid for the extended periods of time previously employed leads to formation of three nitrobenzo[a]pyrene isomers. Some of the isomers are direct-acting mutagens for S. typhimurium with considerably greater mutagenicity than benzo[a]pyrene. In attempts to minimize reaction of chemicals other than aromatic amines, we found that only very brief reaction periods are required for complete reaction of nitrous acid with representative aromatic amines, essentially eliminating their mutagenicity. During such brief reaction periods modification of benzo[a]pyrene is negligible, but phenols react readily. Chromatographic analysis indicated that reaction of nitrous acid with aromatic amines leads to the formation of families of products, therby increasing the complexity of the mixtures in which the amines may occur. Thus, experiments examining the effects of nitrous acid on the mutagenic activity of complex mixtures must be carefully designed, and the results must be interpreted cautiously. (JMT)

62177 **Photodynamic effects of dyes on bacteria. IV. Lethal effects of acridine orange and 460- or 500-nm monochromatic light in strains of Escherichia coli that differ in repair capability.** Hass, B.S.; Webb, R.B. (Argonne National Lab., IL). *Mutation Research;* **81**: 277-285(1981). Contract W-31-109-ENG-38.

Lethal effects of acridine orange (AO) and monochromatic 460- or 500-nm light were measured in strains of Escherichia coli that differ in repair capability. Strains WP10 (recA) and B/sub s-1/ (lexA uvrB) were more sensitive by factors of 17 to 281 (based on F_{37} values) than the strain which tested the most resistant in the presence of AO at both wavelengths, WP2s (uvrA). The difference in sensitivity between the recA and WP2s strains was greater with AO and 500-nm light (281-fold) than with AO and 460-nm light (115-fold) suggesting that although DNA lesions produced by either 460-nm or 500-nm light in the presence of AO are rendered non-lethal by rec^+ lex^+ -dependent repair processes, such repair is more efficient for the lesions produced by 500-nm light.

62178 **The effect of indomethacin, prednisolone and cis-4-hydroxyproline on pulmonary fibrosis produced by butylated hydroxytoluene and oxygen.** Kehrer, J.P.; Witschi, H. (Oak Ridge National Lab., TN). *Toxicology;* **20**: 281-288(1981). Contract W-7405-ENG-26.

Pulmonary fibrosis was produced in mice treated with butylated hydroxytoluene (BHT) 400 mg/kg and immediately exposed to 80% oxygen for 3 days. This treatment regimen resulted in 47% mortality. Surviving mice exhibited significant accumulations of pulmonary collagen as evidence by increases in total lung hydroxyproline levels. The administration of indomethacin (4 mg/kg/day) on days 1-6 after BHT decreased mortality to 14% and diminished the accumulation of collagen in lung tissue. Indomethacin also enhanced survival when administered on days 1-3 after BHT/O_2 but had no effect on lung collagen levels. Treatment with indomethacin on days 4-6 after BHT had no beneficial effect. The administration of prednisolone (60 mg/kg/day) on days 1-3, 1-6, or 4-6 after BHT decreased mortality but had not effect on accumulation of lung collagen. Cis-4-hydroxyproline (400 mg/kg/day) also had no effect on pulmonary fibrosis but did enhance survival when given on days 1-3 after BHT. Administering prednisolone (60 mg/kg/day) on days 1-6 after BHT to mice left in room air produced significantly more pulmonary fibrosis than in BHT-treated mice given saline. These data support the use of the BHT/O_2 model of pulmonary fibrosis for screening potential antifibrotic agents. The possibility that corticosteroid treatment may enhance pulmonary fibrosis in a damaged lung is also demonstrated.

5604 Other Environmental Pollutant Effects

62179 **(N—82-17844) USSR report: life sciences effects of nonionizing electromagnetic radiation, No. 4.** (Joint Publications Research Service, Arlington, VA (USA)). Jan 1982. 5p. (JPRS—79780). NTIS.

Translated from Fiz. Zh. (USSR); 27: No. 1, 121-124(Jan-Feb 1981).

The biological effects of commercial frequency electromagnetic fields (CFEMF) generated by high voltage electric power lines on the gonads of male rats were investigated. The effect of CFEMF on the endocrine function of rat tests consists of an intensification of steroidogenetic processes and a corresponding increase in the activity of the steroid delta(5)-3 beta-o1 dehydrogenase. No appreciable changes in testosterone levels in peripheral blood plasma were observed following CFEMF irradiation for a period of four months.

62180 **(N—82-17844) USSR report: life sciences effects of nonionizing electromagnetic radiation, No. 4.** (Joint Publications Research Service, Arlington, VA (USA)). Jan 1982. 5p. (JPRS—79780). NTIS.

Translated from Kardiologiya; 21: No. 4, 82-85(Apr 1981).

The effect of alternating magnetic fields of various voltages and exposures on the metabolism of carbohydrates, macroergic phosphates, and low molecular nitrogen compounds in the rat heart was investigated. The direction and degree of metabolic disturbances in the myocardium after exposure to industrial frequency alternating magnetic fields depend on the voltage of the field and the length of exposure. An alternating magnetic field with a voltage of 32 kA/m delays oxidation and phosphorylation processes without affecting their coupling, and the proportion of oxidized carbohydrates increases as compared with fatty acids. The conversion of carbohydrates and of nitrogen substances are stimulated by an alternating magnetic field with a voltage of 7.5 kA/m.

62181 **(N—82-17844) USSR report: life sciences effects of nonionizing electromagnetic radiation, No. 4.** (Joint Publications Research Service, Arlington, VA (USA)). Jan 1982. 6p. (JPRS—79780). NTIS.

Translated from Biol. Nauki (USSR); No. 5, 24-28(May 1981).

The effect of electromagnetic waves in the millimeter band on the synthesis and activity of pencillinase produced by strains of Staphylococcus aureus and Escherichia coli is examined. Experiments demonstrated that wave lengths of 6,478 and 6,468 mm inhibit the induction of the enzyme by St. aureus. However, this type of radiation does not affect the activity of the exoenzyme released from the St. aureus strain, and also does not affect the constitutive synthesis of the penicillinase by E. coli. The relationship of effect of the duration of irradiation, bacterial population, and the strength of current density is elucidated.

62182 **(N—82-17844) USSR report: life sciences effects of nonionizing electromagnetic radiation, No. 4.** (Joint Publications Research Service, Arlington, VA (USA)). Jan 1982. 10p. (JPRS—79780). NTIS.

Translated from Radiobiol. (USSR); 21, No. 2, 163-171(Mar-Apr 1981).

The main patterns of the effects of millimeter radiation of nonthermal intensity on various biological objects are discussed on the molecular, cellular levels, as well as on the level of complex living organisms. The main objects of the studies were hemoglobin

and erythrocytes and human blood, E. coli, Staphylococcus aureus, Aspergilla mold, mice and rats.

62183 **(N—82-17844) USSR report: life sciences effects of nonionizing electromagnetic radiation, No. 4.** (Joint Publications Research Service, Arlington, VA (USA)). Jan 1982. 37-43p. (JPRS—79780). NTIS.

Translated from Radiobiol. (USSR); 20, No. 1, 3-8(Jan.-Feb. 1980).

On the basis of analysis of the current state of the radiobiology of nonionizing radiation, the need for accelerated development of basic research on the biological action of these radiations, especially in the radio-frequency range, is substantiated. An objective is set for accumulation of experimental data on questions of reversibility and cumulative effects, selectivity, specificity and additivity, direct and indirect action, sensitivity, adaptation and stability in regard to radiation, species differences, and possible mechanisms of operation of radiation.

62184 **(N—82-17848) Physical factors of environment as hygiene problem.** Shandala, M.G. (Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Research Group). Jan 1982. 10p. Joint Publications Research Service, Arlington, VA.

The direction of scientific research into the effect of physical factors influenced by industrial and technical development on the environment is surveyed. Physical factors considered are mechanical, thermal, optical, electrical, magnetic, electromagnetic and ionizing radiation. Findings on the effect of these factors on environmental hygiene are reviewed.

62185 **(PB—82-189770) Health hazard evaluation report No. HE-80-053-795, AT and T longlines, Raggersville, Ohio.** Hartle, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Jan 1981. 6p. (HE—80-053-795). NTIS, PC A02/MF A01.

Worker exposures to polychlorinated-biphenyls (1336363) (PCB), asbestos (1332214), contaminated drinking water, and incident nonionizing radiation were surveyed on February 4, 1980 at the AT and T Longlines facility (SIC-4899) in Raggersville, Ohio. The evaluation was requested by the Communication Workers of America, Local 4354, on behalf of the three telecommunications technicians. Survey methods were not reported. No detectable levels of radiation were found, and no asbestos was recovered. Polyisobutylene (9003274) impregnated paper was identified as the PCB containing material. Mutagenicity testing of the drinking water was negative. The author concludes that no asbestos, PCB, radiation, or contamination hazards exist at this facility.

62186 **(JPRS—79780) USSR report: life sciences effects of nonionizing electromagnetic radiation, No. 4.** (Joint Publications Research Service, Arlington, VA (USA)). Jan 1982. Translation of various articles. 62p. NTIS.

The effects of nonionizing electromagnetic radiation on organisms and tissues are discussed.

57 Health And Safety

REFER ALSO TO CITATION(S) 61380, 61543, 62139, 62157, 62185

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 60937, 60977, 61000, 61006, 62036

62187 **(USGS—474-314) Summary of hydraulic data and abridged lithologic log of ground-water test well 6(J-13) Jackass Flats, Nevada Test Site, Nye County, Nevada. Technical letter NTS-50.** Doyle, A.C.; Meyer, G.L. (Geological Survey, Denver, CO (USA)). 26 Apr 1963. Contract AI08-76DP00474. 12p. NTIS, PC A02/MF A01. Order Number DE82021613.

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This technical letter summarizes the results of drilling groundwater test well 6 and presents an abridged lithologic log, well construction information, and results of hydraulic tests made in the well. Test well 6 (designated well J-13 by NASA) is one of several wells drilled in support of the Long Range Program of the US Geological Survey to study the geology and hydrology of the Nevada Test Site. The well is located near the east rim of Forty-mile Canyon wash in western Jackass Flats, about 12 miles north of Lathrop Wells, Nye County. The Nevada State Coordinates of the site are N 749,209 and E 579,651, and the altitude of the land surface is about 3318 feet.

62188 **Iridium anomaly approximately synchronous with terminal eocene extinctions.** Alvarez, W. (Univ. of California, Berkeley); Asaro, F.; Michel, H.V.; Alvarez, L.W. *Science (Washington, D.C.);* **216**: 886-888(21 May 1982). Contract W-7405-ENG-48.

An iridium anomaly has been found in coincidence with the known microtektite level in cores from Deep Sea Drilling Project site 149 in the Caribbean Sea. The iridium was probably not in the microtektites but deposited simultaneously with them; this could occur if the iridium was deposited from a dust cloud resulting from a bolide impact, as suggested for the anomaly associated with the Cretaceous-Tertiary boundary. Other workers have deduced that the microtektites are part of the North American strewn tektite field, which is dated at about 34 million years before present, and that the microtektite horizon in deep-sea cores is synchronous with the extinction of five radiolarian species. Mass extinctions also occur in terrestrial mammals within 4 million years of this time. The iridium anomaly and the tektites and microtektites are supportive of a major bolide impact about 34 million years ago.

62189 **Geological evolution and economic geology of the Burdekin River region, Queensland.** Levingston, K.R.; Oldham, W.H. Canberra, Australia; Bureau of Mineral Resources, Geology and Geophysics (1981). 72p.

The geological history of the area is presented, from the Precambrian to the Cainozoic ages. The physiography of the land is described, and the economic aspects of the geology are discussed in relation to metals, fuels (coal and petroleum), and nonmetallic minerals.

5802 Geophysics

REFER ALSO TO CITATION(S) 61006, 61193, 61964

62190 **(DOE/ET/28341—T1) Multi-site magnetotelluric measurement system with real-time data analysis. Final technical report No. 210.** Becker, J.D.; Bostick, F.X. Jr.; Smith, H.W. (Texas Univ., Austin (USA). Electrical Engineering Research Lab.). Sep 1981. Contract AS05-77ET28341. 189p. NTIS, PC A09/MF A01. Order Number DE82020596.

Portions of document are illegible.

A magnetotelluric measurement system has been designed to provide a more cost effective electrical method for geothermal and mineral exploration. The theoretical requirements and sensitivities of the magnetotelluric inversion process were specifically addressed in determining system performance requirements. Significantly reduced instrument noise levels provide improved data quality, and simultaneous measurement at up to six locations provides reduced cost per site. Remotely located, battery powered, instrumentation packages return data to a central controlling site through a 2560 baud wire-line or radio link. Each remote package contains preamplifiers, data conditioning filters, and a 12-bit gain ranging A-D converter for frequencies from 0.001 Hz to 8 Hz. Data frequencies above 8 Hz are processed sequentially by a heterodyne receiver to reduce bandwidth to within the limits of the 2560 baud data link. The central data collection site provides overall control for the entire system. The system operator interacts with the system through a CRT terminal, and he receives hard copy from a matrix graphics printer. Data from the remote packages may be recorded in time sequence on a magnetic tape cartridge system, or an optional Hewlett-Packard 21MX minicomputer can be used to perform real-time frequency analysis. The results of this analysis provide

feedback to the operator for improved evaluation of system performance and for selection of future measurement sites.

62191 **(DOE/ET/28368—T1) Real-time Fourier transformation of magnetotelluric data. Final technical report No. 203.** Wight, D.E.; Bostick, F.X. Jr.; Smith, H.W. (Texas Univ., Austin (USA). Electrical Engineering Research Lab.). 15 Dec 1977. Contract AS05-76ET28368. 99p. NTIS, PC A05/MF A01. Order Number DE82020245.

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Power spectra estimates for magnetotelluric data are computed using a continuous Fourier transformation technique which is implemented in real time on a Hewlett-Packard 9825 programmable calculator. This technique, known as cascade decimation, applies 32 point sine and cosine transforms to sequences of data produced by successively applying a low pass digital filter and decimation by two operator to the original data. The resulting spectra estimates are naturally spaced on a log frequency scale and represent the average of independent samples in time. Descriptions of the algorithms for cascade decimation are presented along with their implementation on the HP-9825. Also, a comparison is presented between cascade decimation and FFT for the computation of power spectra estimates for magnetotelluric data.

62192 **(FOA-C—20427-T1) Seismology 1980, nuclear test ban verification. Earthquake and earth resource investigation.** Tygaard, B. (Research Inst. of National Defence, Stockholm (Sweden)). Oct 1981. 69p. NTIS, PC A04/MF A01.

Seismological projects are reported, including nuclear explosion monitoring, the development of international data centers, seismic risk estimation for nuclear power plants, oil exploration using seismic methods, and crystalline rock investigation using seismic cross hole measurements. The Swedish seismic network is described. In 1980, China conducted 1 nuclear test, France 11, Britain 3, the US 14, and the USSR 21. Apart from the Chinese test, the explosions were underground and within the 150 kton limit. France is the only country which increased the number of tests compared with previous years.

62193 **(UCRL—87785) Geological-fracture mapping using electromagnetic geotomography.** Ramirez, A.L.; Deadrick, F.J.; Lytle, R.J. (Lawrence Livermore National Lab., CA (USA)). 29 Jun 1982. Contract W-7405-ENG-48. 10p. (CONF-820820—1). NTIS, PC A02/MF A01. Order Number DE82019317.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

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This article describes the evaluation of a new geophysical technique used to map fractures between boreholes: electromagnetic geotomography used in conjunction with salt water tracers. An experiment has been performed in a granitic rock mass. Geotomographic images have been generated and compared with borehole geophysical data: neutron logs, acoustic velocity logs, caliper logs and acoustic televiewer records. Comparisons between the images and the geophysical logs indicate that clusters of fractures were detected but single fractures were not.

62194 **Parameters and a magnitude moment relationship from small earthquakes observed during hydraulic fracturing experiments in crystalline rocks.** Pearson, C. (Earth and Space Sciences Divsion, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Geophysical Research Letters;* **9**: No. 4, 404-407(Apr 1982).

Using source parameters estimated from seismic spectra and magnitudes estimated from coda lengths, we demonstrate that the log-linear relationship between moment and magnitude holds for events with magnitudes as low as -6. Using, as a data set, events induced by hydraulic fracturing experiments at the Fenton Hill, New Mexico, Hot Dry Rock (HDR) geothermal site, we find that the relationship between magnitude M and seismic moment (Mo) is log (Mo) = 17.27+0.77 M Moreover, the linear relationship between seismic moment and source radius (r) holds for the Fenton Hill microearthquakes. Analyses of the Fenton Hill data yield the following relationship. log (r) = 2.28+0.19 log (Mo)

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 60713, 61003, 61007

62195 **(CISE—1635) Determination of metallic elements in interstitial waters of aquatic sediments.** Boniforti, R.; Cambiaghi, M.; Frigieri, P. (Centro Informazioni Studi Esperienze, Milan (Italy)). 1980. 16p. (In Italian). (CONF-801291—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82902845.

From 4. congress of limnology and oceanography; Chiavari, Italy (1 Dec 1980).

Results are given for the determination of Mn, Sr, Ni, Fe, Cu, and Sb concentrations in interstitial waters extracted from marine sediments from the Gulf of Spezia and from lake sediments of the Massaciuccoli Lake and the Torre del Lago. Tabulated data are given on the theoretical concentrations and experimental heavy metals extracted from rich sediments and organic matter, and the concentration of the aforementioned metals in various sites of the aforementioned water bodies. The significant difference between the Mn and Cu concentrations is superficial and deep strata of marine sediments is attributed to the fact that the organic C content is higher in the superficial layer and that the humus's capacity for Cu is maximum at that layer.

62196 **(RHO-BW-SA—201-P) Stress ratio determination from the core-disking phenomenon.** Lehnhoff, T.F.; Stefansson, B.; Thirumalai, K. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Aug 1982. Contract AC06-77RL01030. 22p. (CONF-820803—14). NTIS, PC A02/MF A01. Order Number DE82021718.

From 23. US symposium on rock mechanics; Berkeley, CA, USA (25 Aug 1982).

The ability to predict in situ stress conditions from standard core samples offers planning and site-selection advantages for most underground facilities. This paper presents an empirical relation for estimating the horizontal to vertical stress ratio in basalt. The resulting estimates can then be used to help assess the extent to which measurement of in situ stress is required. The core disking phenomenon has long been used as an indicator of high in situ stress. It is concluded that disks form as the result of tensile failure initiation rather than shear failure initiation of the core. It is deduced that the tensile failure begins at the edge of the core and propagates toward the center in shear rather than beginning at the center and propagating outward. An empirical relation for horizontal to vertical stress ratio variation with depth has been developed and is shown to agree substantially with previous measured horizontal to vertical stress ratios for locations in several areas of the world. The stress-ratio predictions are justified based on finite-element studies using linear elastic analysis and also nonlinear (tension cut-off) analysis. Indications of fracture propagation paths were determined from the analyses. The shape of the predicted propagation path agrees well with physical observations.

62197 **(SAND—82-0678) Use of laboratory triaxial-creep data and finite-element analysis to predict observed creep behavior of leached salt caverns.** Preece, D.S.; Stone, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1982. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01. Order Number DE82022235.

Portions of document are illegible.

An increasing interest is being shown worldwide in using leached salt caverns to store oil and natural gas. A critical factor in the use of existing caverns and the design of new ones is the creep behavior of the salt surrounding the caverns. An understanding of this behavior is being gained by using laboratory triaxial creep data as material property input to finite element computer programs designed to calculate displacements and stresses due to creep. An important step in verifying these predictive methods is the comparison of field data from existing caverns with finite element analyses which incorporate the material properties and geometry of each site. This comparison has been made for caverns in the Eminence Dome (Mississippi), West Hackberry Dome (Louisiana), and Bayou Chocktaw Dome (Louisiana) with reasonably good correlation being obtained between measured and predicted volumetric re-

sponse of the caverns. These comparisons are discussed in this paper.

62198 **Thermodynamics of plagioclase-melt equilibria in the system albite-anorthite-diopside.** Henry, D.J.; Navrotsky, A.; Zimmerman, H.D. (Arizona State Univ., Tempe). *Geochimica et Cosmochimica Acta;* **46**: No. 3, 381-391(Mar 1982).

An analysis of thermochemical and phase equilibrium data for high plagioclase solid solutions, glasses, and liquids in the system albite-anorthite-diopside produces an internally consistent model of mixing properties of crystals and melts. The mixing behavior of high temperature plagioclases is described adequately by positive heats of mixing and the aluminum-avoidance entropy model. This model predicts plagioclase exsolution with compositions in the region of Bogglid and Huttenlocher intergrowths but provides no evidence for the peristerite gap. Liquids in the region of the plagioclase saturation surface of the system albite-anorthite-diopside are shown to have entropies of mixing significantly less positive than predicted by the "two-lattice" model, which appeared adequate for the pyroxene saturation surface of that system. Along the albite-anorthite binary these deviations are not consistent with aluminum avoidance in the liquid, but can be described by an empirical "regular" excess entropy term which allows a satisfactory calculation of the albite-anorthite binary liquidus loop. The magnitude of this negative excess entropy term can be explained by the assumption of strong Ca-Al charge balance (without restriction of Al-O-Al contacts) which leads to a vanishingly small entropy arising from Na-Ca mixing.

5804 Geochemistry

REFER ALSO TO CITATION(S) 60937, 61000, 61203, 61204, 61845, 62042, 62188

5805 Oceanography

REFER ALSO TO CITATION(S) 60860, 61948, 61975

62199 **Potassium 40 in the ocean, and how to live with it.** Roberts, A. (Fermi National Accelerator Laboratory, Batavia, Ill.). pp 139-145 of DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 1 - array studies. Roberts, A. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

The detection by the DUMAND array of Cerenkov radiation produced by high-energy charged particles in the presence of the beta-decay of naturally occurring K-40 in the ocean is considered. The Cerenkov flux produced by K-40 decay yielding 43 quanta/disintegration in the range 300 to 630 nm at any wavelength crossing a sq cm in an infinite ocean is calculated from the variation of attenuation length with wavelength in the ocean, and a value close to 150 quanta/sq cm per sec is obtained for a standard 20-m ocean at a wavelength of 470 nm. The false triggering rate of the DUMAND array due to fluctuations in the background level of K-40 flux is then examined, taking into account the effects of signal light intensity and system bandwidth. For a Poisson distribution of background counts with a mean of 0.0075 counts for the expected signal duration of 30 nsec, a threshold value of just over three counts is found to correspond to a false trigger rate of 1/sec, and a signal intensity of 19 quanta/sq m. It is noted that a high-gain dynode would be helpful in minimizing the false triggering rate and permitting a clear distinction to be made between signal and background.

64 PHYSICS RESEARCH

62200 **(NP—2903868) Annual report of the Bonn University Physics Institute for 1978-1979.** Menze, D. (ed.). (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). 1979. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82903868.

Portions of document are illegible.

An overview is presented of Institute activities in the areas of accelerator research (500-MeV synchrotron, 2.5-GeV synchrotron, electron-stretcher apparatus), high-energy physics (photo production of nucleons in the energy range of pion-nucleon resonance), space research (atmospheric studies of Jupiter, Venus, upper atmospheric gas studies), experimental method (target technology), theoretical physics (general mathematical and field theory, quantum mechanics). An enumeration is also given of scientific papers, colloquia, and participants in research sponsored by the Institute during the report period.

6401 Astrophysics And Cosmology

62201 **(AD-A—114269/4) Solar flare studies. Final scientific report 1 Jul 76-31 Jan 82.** Canfield, R.C. (California Univ., San Diego, La Jolla (USA). Center for Astrophysics and Space Sciences). 20 Mar 1982. 547p. NTIS, PC A23/MF A01.

The primary objective of the research described in this report was increased understanding of solar flares. In the course of the research, many tasks were carried out, which achieved not only the primary objective, but also secondary objectives in related areas. The research program started with active participation in the Skylab Solar Flare Workshop. New observations of solar flare spectra were obtained and interpreted in terms of basic solar flare mechanisms. It was shown that the basic process by which the X-ray radiation of flares is created is by heating the flare plasma to temperatures of about ten million degrees, through evaporation of the chromosphere. This process is driven both by beams of accelerated electrons and by thermal conduction. However, in the major flare for which data were interpreted, the principal energy release mechanism was found to be thermal in nature, implying that most of the flare energy is released in the form of heat, and not charged particles. Theoretical modeling methods were developed for understanding the spectra solar flares. These methods were applied to flare loop dynamics. The spectral signatures of both chromospheric evaporation and beams of accelerated electrons were established. Finally, a theorectical program of theoretical magnetohydrodynamic stability studies was begun.

62202 **(ITEP—134(1981)) Baryons in multicolor chromodynamics.** Ioffe, B.L.; Shifman, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1981. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702613.

In the framework of quantum chromodynamics baryons with the 1/2 spin are investigated in the limit of a large number of colors, N $\rightarrow$ infinity. A formula expressing the baryon mass in terms of quark condensate is obtained. The sum rules for the borel two- point function are derived. The Goldberger-Treiman and Adler- Weisberger relations and properties of the pion-nucleon interactions are discussed. The pion-nucleon coupling constant is shown to be proportional to Nsup(1/2). The arguments are given in favour of the existence of a large number of multiquark resonances in the baryon-antibaryon system.

62203 **(LA-UR—82-2302) Application of two-time methods in stellar pulsations.** Pesnell, W.D.; Regev, O.; Buchler, J.R. (Los Alamos National Lab., NM (USA); Florida Univ., Gainesville (USA). Dept. of Physics). 28 Jul 1982. Contract W-7405-ENG-36. 6p. (CONF-8206101—4). NTIS, PC A02/MF A01. Order Number DE82021924.

From Conference on pulsations in classical and cataclysmic variable stars; Boulder, CO, USA (1 Jun 1982).

The method of two-time expansions is extended to include the effects of the outer, non-adiabatic layers in stellar pulsation. The evolution of pulsating stellar models can be examined, including the approach to limit cycle behavior. The method is demonstrated by a calculation of the eigenvectors for a β Cepheid model. It is argued that the method is promising as a practical tool for treating the approach to limiting oscillations, as well as resonant and multimode behavior.

62204 **(LA-UR—82-2304) Double-mode pulsation.** Cox, A.N. (Los Alamos National Lab., NM (USA)). 30 Jul 1982. Contract W-7405-ENG-36. 14p. (CONF-8206101—3). NTIS, PC A02/MF A01. Order Number DE82021925.

From Conference on pulsations in classical and cataclysmic variable stars; Boulder, CO, USA (1 Jun 1982).

Double mode pulsation is a very pervasive phenomenon in stars all over the Hertzsprung-Russell diagram. In order of increasing radius, examples are: ZZ Ceti stars, the sun, the δ Scuti stars, RR Lyrae variables, the β Cephei variables and those related to them, Cepheids, and maybe even the Mira stars. These many modes have been interpreted as both radial and nonradial modes, but in many cases the actual mode has not been clearly identified. Yellow giants seem to be the most simple pulsators with a large majority of the RR Lyrae variables and Cepheids showing only one pulsation period. We limit this review to those very few cases for classical Cepheids and RR Lyrae variables which display two modes. For these we know many facts about these stars, but the actual cause of the pulsation in two modes simultaneously remains unknown.

62205 **(LA-UR—82-2347) Radial-pulsation properties of neutron-star models.** King, D.S.; Cox, A.N.; Hodson, S.W. (New Mexico Univ., Albuquerque (USA); Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 5p. (CONF-8206101—8). NTIS, PC A02/MF A01. Order Number DE82021775.

From Conference on pulsations in classical and cataclysmic variable stars; Boulder, CO, USA (1 Jun 1982).

Preliminary results of a study of the linear, nonadiabatic, radial-pulsation properties of neutron-star models are presented. Sequences of pure iron models with masses of 1.0 M/sub solar/ and 1.8 M/sub solar/ and a range of luminosities and effective temperatures are considered. Magnetic fields are ignored. The densities of the envelopes at their lower boundary range up to rho $\sim 10^{12}$ g/cm^3. Equation of state and opacity tables are modifications of those provided by the Los Alamos opacity library (Huebner, et al., 1977). The motivation for this study was to determine whether or not variations of the iron opacity in the outer layers might produce pulsational instability.

62206 **(LA-UR—82-2461) 1D thermonuclear model for x-ray transients.** Wallace, R.K. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 6p. (CONF-820747—1). NTIS, PC A02/MF A01. Order Number DE82021896.

From Accreting neutron star conference; Garching, F.R. Germany (1 Jul 1982).

Portions of document are illegible.

The thermonuclear evolution of a 1.41 M solar mass neutron star, with a radius of 14.3 km, accreting various mixtures of hydrogen, helium, and heavy elements at rates of 10^{-11} to 10^{-10} M solar mass/yr is examined, in conjunction with S.E. Woosley and T.A. Weaver, using a one-dimensional numerical model. We have ignored any effects due to general relativity or magnetic fields. Two cases shall be discussed. In both models, the accretion rate is such that the hydrogen shell burns to helium in steady state, with the hydrogen burning stabilized by the β-limited CNO cycle. A thick helium shell is produced, which is eventually ignited under extremely degenerate conditions, producing a thermonuclear runaway.

62207 **(LA-UR—82-2558) X-ray transients as seen by Vela, 1969-1979.** Terrell, J.; Priedhorsky, W.C.; Belian, R.D.; Conner, J.P.; Evans, W.D. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 4p. (CONF-820748—1). NTIS, PC A02/MF A01. Order Number DE82022013.

From Workshop on accreting neutron stars; Munchen, F.R. Germany (18 Jul 1982).

Portions of document are illegible.

Vela spacecraft 5A and 5B were launched into orbit in May 1969, to monitor for nuclear tests in space. These spacecraft were among the first to be capable of x-ray astronomy. One of these, Vela 5B, monitored the entire x-ray sky for the unprecedented period of 10 years, from May 1969 to June 1979. Over the last several years the data produced have been re-analyzed to produce a series of skymaps. These have now been made into a movie, in color, showing the changes in the x-ray sky over the period 1969-1976.

62208 **(N—82-14996) Interstellar grains.** Hoyle, F.; Wickramasinghe, N.C. (University Coll., Cardiff (UK)). Nov 1980. 26p. NTIS, PC A03/MF A01.

In Interstellar Grains Investigated and Comets Proposed as a Vehicle for Panspermia, pp 26, See N—82-14995.

Interstellar extinction of starlight was observed and plotted as a function of inverse wavelength. Agreement with the calculated effects of the particle distribution is shown. The main kinds of grain distinguished are: (1) graphite spheres of radius 0.02 microns, making up 10% of the total grain mass (2) small dielectric spheres of radius 0.04 microns making up 25% and (3) hollow dielectric cylinders containing metallic iron, with diameters of 2/3 microns making up 45%. The remaining 20% consists of other metals, metal oxides, and polysiloxanes. Absorption factor evidence suggests that the main dielectric component of the grains is organic material.

62209 **(UCRL—87815) Theory of bending waves with applications to disk galaxies.** Mark, J.W.K. (Lawrence Livermore National Lab., CA (USA)). 1982. Contract W-7405-ENG-48. 30p. (CONF-8205108—1). NTIS, PC A03/MF A01. Order Number DE82019063.

From UBC-UM conference on the milky-way; Vancouver, BC, Canada (17 May 1982).

A theory of bending waves is surveyed which provides an explanation for the required amplification of the warp in the Milky Way. It also provides for self-generated warps in isolated external galaxies. The shape of observed warps and partly their existence in isolated galaxies are indicative of substantial spheroidal components. The theory also provides a plausible explanation for the bending of the inner disk (<2 kpc) of the Milky Way.

62210 **Isotopic abundance ratios and Dirac's large numbers hypothesis.** Norman, E.B. (Nuclear Physics Laboratory, University of Washington, Seattle). *Astrophysical Journal;* **258**: No. 1, 41-42(1 Jul 1982).

Some effects of the spontaneous creation of nucleons within atomic nuclei are examined. It is shown that certain observed isotopic abundance ratios are in sharp disagreement with those expected from a recently proposed model of multiplicative creation based upon Dirac's Large Numbers Hypothesis.

62211 **Generation of isothermal perturbations in the very early universe.** Bond, J.R.; Kolb, E.W.; Silk, J. (Astronomy Department, University of California, Berkeley). *Astrophysical Journal;* **255**: No. 2, 341-360(15 Apr 1982).

If the baryon asymmetry in the universe is produced at a temperature $\sim 10^{15}$ GeV as a result of baryon nonconservation, as predicted in grand unified theories, then perturbations in the baryon density fluctuations. Isothermal (entropy) perturbations can be created as a result of spatial variations in the local expansion rate which can result from spatial inhomogeneities in the cosmological constant, scalar curvature, or shear (and vorticity). We discuss the role of each in turn. We calculate numerically the entropy per baryon created in Bianchi I universe with shear, using model systems based upon the SU(5) grand unified theory. We calculate an effective viscosity in this theory, and use it to show that viscous damping of shear is not sufficiently large to smooth the universe. The shear dissipation after baryon synthesis generates sufficient entropy that we can constrain the magnitude of the decaying mode of shear to values which are negligible by the neutrino decoupling and primordial nucleosynthesis eras. The survival of shear inhomogeneities results in isothermal perturbations being generated. these could be of the magnitude required for the gravitational instability theory of galaxy formation if decaying modes are preferentially selected over growing modes, and galaxy scale shear inhomogeneities exist at very early times.

62212 **Colors of the pulsations and flickering of Sy Cancri during outburst.** Middleditch, J.; Cordova, F.A. (Los Alamos National Laboatory, Los Alamos, New Mexico). *Astrophysical Journal;* **255**: No. 2, 585-595(15 Apr 1982).

The spectra of the short period (~30 s) oscillations and flickering of the dwarf nova Sy Cnc have been determined by simultaneous measuring the optical flux in three broad, contiguous spectral bands during an optical outburst of the star. The spectrum of the oscillation rises too rapidly toward short wavelengths to be consistent with any simple thermal model. The colors of the flickering are even more extreme (i.e., more ultraviolet) than those of the pulsations. No timing differences were detected to a fraction of a second between the ultraviolet (U), cyan (B+V, or C) and red (R, to 9000 A) bands of the pulsations; thus, the optical oscillations appear to arise from a single physical location in the binary system. Without a detailed study of a more complicated class of models, which may include recombination radiation from H I, He I, and He II in addition to a thermal model, it is impossible to assign a temperature to the oscillations and thereby determine whether they are produced directly on the white dwarf or in the accretion disk.

62213 **Ultraviolet spectrophotometry of 2A 1822—371: A bulge on the accretion disk.** Mason, K.O.; Cordova, F.A. (Space Sciences Laboratory, University of California, Berkeley). *Astrophysical Journal;* **255**: No. 2, 603-609(15 Apr 1982).

The X-ray source 2A 1822—371 has been observed with the IUE satellite over an 8 hour period. Long and short wavelength exposures of duration 45 or 60 minutes were alternated in order to resolve the 5.57 hr photometric modulation of the star. The data provide evidence that the shape of the 5.57 hr modulation evolves smoothly with energy between extremes defined by the optical and X-ray curves. The far-UV light curve is more deeply modulated than the X-ray light curve. The combined ultraviolet and the UBV band optical data can be fitted with a single blackbody of temperature 2.7 x 10^4 K, or an optically thick disk model with parameters T/sub asterisk/ = 1.2 x 10^5 K and R/sub out//R/sub in/~30. A single power-law model does not adequately represent the continuum. There is evidence of absorption due to the 2200 A interstellar feature whose depth requires a color excess, E(B—V)~0.1, with 3 σ upper and lower bounds of 0.29 and 0.01. Emission lines of C IV 1550 A and N V 1240 A are detected in the UV spectrum. The work of Mason et al. and White et al. suggests that the optical and ultraviolet emission arises in an accretion disk, whereas the X-radiation is emitted from a scattering cloud that envelopes a central compact object. In the present paper, the 5.57 hr optical, X-ray and ultraviolet modulation of 2A 1822—371 is intrepreted as the result of partial occultation of the emitting region by a comparison star and a bulge on the outer accretion disk. X-ray heating of the bulge will probably also contribute to the modulation at optical and ultraviolet wavelengths.

62214 **Nature of particles in Saturn's spokes.** Thomsen, M.F.; Goertz, C.K.; Northrup, T.G.; Hill, J.R. (University of California, Los Alamos National Laboratory Los Alamos, NM 87545). *Geophysical Research Letters;* **9**: No. 4, 423-426(Apr 1982).

An observed deviation of the angular velocity of spoke features from the Keplerian value can yield the charge to mass ratio of spoke particles. Published observations of spoke motion are consistent with q/m in the neighborhood of -10 coul/kg. Since a lower llimit on q is one electronic charge, this value yields a lower limit to the size of spoke particles of about 10^{-2} μm. The criteria for electrostatically ejecting small particles from larger parent bodies indicate an upper limit of about 10^3 m for the parent bodies. Stability of the grains against electrostatic disruption or field emission yields an upper limit of ~3 μm for the spoke particle size and leads to the conclusion that the spoke particles must consist of material which is stronger than loose dust balls.

62215 **Primary cosmic ray electron spectrum 1978-1980.** Evenson, P.; Krawczyk, L.; Moses, D.; Meyer, P. (Chicago Univ., IL (USA). Enrico Fermi Inst.). pp 254 of Conference papers. 17. International cosmic ray conference, Paris, 13-25 July 1981. Vol. 3, SH1 Session. Paris, France; Commissariat a l'Energie Atomique (1981).

From 17. international cosmic ray conference; Paris, France (13 Jul 1981).

62216 **DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 2 - UHE interactions, neutrino astronomy.** Roberts, A. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979). 383p. (CONF-7808107—).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

The volume covers categories on inelastic neutrino scattering and the W-boson, and other ultra-high-energy processes, on pulsars, quasars and galactic nuclei, as well as other point sources and constants from gamma ray astronomy. Individual subjects include weak intermediate vector bosons and DUMAND, the Monte Carlo simulation of inelastic neutrino scattering in DUMAND, and Higgs boson production by very high-energy neutrinos. The observability of the neutrino flux from the inner region of the galactic disk, the diffuse fluxes of high-energy neutrinos, as well as the significance of gamma ray observations for neutrino astronomy are also among the topics covered.

62217 **Luna 24 origins - some trace element constraints.** Jovanovic, S.; Jensen, K.J.; Reed, G.W. Jr. (Argonne National Laboratory, Argonne, Ill.). pp 695-700 of Mare Crisium: the view from Luna 24. Proceedings of the conference, Houston, TX, December 1-3, 1977. New York, NY; Pergamon Press (1978).

From Conference on Mare Crisium: the view from Luna 24; Houston, TX, USA (1 Dec 1977).

Luna 24 basaltic material originated in the particular volume of the lunar crust that produced Apollo 11 and Luna 16 basaltic material. It has the same Clr/P2O5 (r residual) signature. Ru-Os contents (Barsukov et al., 1977) and a number of radiogenic age measurements place Luna 24 basalt origins stratigraphically in a layer between those from which Apollo 15 and Apollo 11 and 17 basalts were derived.

6402 Atmospheric Physics

62218 **(AD-A—114376/7) Electron beam transport in the ionosphere - energy deposition and optical emissions based upon the combined effects of plasma turbulence and particle-particle interactions. Final report Jan-Dec 81.** Strickland, D.J.; Lin, D.L.; Pine, V.W.; Schmidt, M.J. (Beers (Roland F.), Inc., Alexandria, VA (USA)). Feb 1982. 71p. NTIS, PC A04/MF A01.

The problem of electron beam propagation in the E-region is examined. A model is developed to describe that part of beam spreading due to plasma turbulence. The basis of the model is that the given turbulence can cause a series of effective displacements delta r(GC) of the beam electron guiding centers through a corresponding series of briefly experienced perpendicular components of the turbulent electric field. Weak turbulence theory is considered and applied to cases of warm and cold beams. A Monte Carlo code has been developed to follow the spreading of the beam electron guiding centers where delta r(GC) is given altitude dependence. An analytic expression is used when delta r(GC) is constant with altitude. The turbulence model is used to examine beam spreading as observed by Davis et al. (1971) and Hallinan et al. (1978). We can generally account for the observed amount of spreading by adding in the contribution due to particle-particle interactions. Optical properties associated with beam energy deposition are also modeled. Most features in the UV and visible portion of the optical spectrum are considered along with their emission efficiencies.

62219 **(AERONOMICA-ACTA-A—233-1981) Chemical fluctuations and incoherent scattering theory in the terrestrial D region.** Kockarts, G.; Wisemberg, J. (Institut d'Aeronomie Spatiale de Belgique, Brussels). 1981. 34p. Institut d'Aeronomic Spatiale de Belgique, Brussels.

The continuum theory of incoherently scattered electromagnetic waves is modified in order to include possible effects of thermally induced chemical fluctuations by introducing fluctuating parts in the production and loss terms of the continuity equations. An equivalent ionospheric model is developed for electrons and for negative and positive ions. A matrix formulation gives simultaneous access to fluctuating parts of each charged component. Numerical

results indicate that chemical fluctuations are important over the height range where negative ions are comparable or the electron concentration. Strong enhancements of the incoherent scatter cross section occur for frequency shifts 20 Hz. A simple approximation is given for the contribution of chemical fluctuations.

62220 **(BMFT-FB-W—81-008) Impedance probe: the electron density experiment onboard the aeronomy satellites aeros. Final report, November 1980.** Neske, E.; Kist, R. (Fraunhofer Inst., Freiburg (West Germany)). Feb 1981. 101p. (In several languages). NTIS, PC A06/MF A01.

The AEROS-B electron density impedance probe (IP) with its main theoretical aspects, technical solution and data acquisition and data reduction are described. The IP subsystems which includes the IP sensor and electronic groups, such as resonance frequency and phase measurement, sensor potential control, measuring program control, and inflight calibration are discussed. Absolute electron densities with high accuracy and spatial resolution in the altitude range 220 to 900 km are measured. Comparisons with accompanying AEROS-B experiments as well as synoptic measurements from ground stations and other satellites are presented. Geophysical phenomena, such as the midlatitude electron density trough, the South Atlantic anomaly, and polar density fluctuations are investigated. (ESA)

62221 **(CRPE-NT—78) Experimental study of instabilities and motion of a streaming ionospheric plasma in the polar zone.** Pignard, J. (Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France)). Sep 1979. 119p. (In French). NTIS, PC A06/MF A01.

A space environment simulator was used in order to show the effect of plasma drift rate on the transfer impedance of a quadrupole HF probe. Results allow for interpretation of the self oscillation frequency shift between the interferometric self oscillating probes onboard the sounding rocket experiment IPOCAMP 2. Data processing for the IPOCAMP 2 experiment, i.e. measurement of the electron density and of the continuous (0 to 20 Hz) and alternating (10 to 200 Hz) electric fields, is explained. Physical parameters of the polar ionosphere were determined. Measurements contribute to a geophysical model of double band plasma instability observed in the E region of the auroral zone.

62222 **(INPE—2119-RPE/343) Particle precipitation and atmospheric x-and gamma-rays in the South Atlantic magnetic anomaly by balloon experiments.** Dacosta, J.M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jun 1981. 10p. NTIS, PC A02/MF A01.

From 1st aeronomy workshop, Brazil-Argentina; Iguacu, Brazil (18-20 Jul 1981).

Particle precipitation from the Van Allen belts into the atmosphere of the South Atlantic magnetic anomaly region, were observed with balloon-borne instrumentation. Balloons carrying onboard charged particle and X-and gamma ray detectors formed by plastic scintillators were used. Measurements of bremsstrahlung X-rays and low energy gamma rays as well as the charged particles themselves were made at the altitude of the stratospheric balloons, and simultaneous measurements of the geomagnetic variations were made by rapid run ground magnetometers.

62223 **(INPE—2172-RPE/388) Numerical simulation of Rayleigh-Taylor instability in the equatorial ionospheric plasma.** Nakamura, Y.; Sobral, J.H.A.; Abdu, M.A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1981. 28p. NTIS, PC A03/MF A01.

From 33rd reuniao anal da SBPC; Salvador, Brazil (Jul 1981).

Ionospheric irregularities near the magnetic equator are studied. A numerical simulation is done for the generation and evolution of the ionospheric bubble based on the theory of the collisional Rayleigh-Taylor instability for two fluids, for the magnetic equatorial region. The regions of depletion in density were assumed to be aligned with the Earth's magnetic field, extending from higher altitudes at the equatorial region down to the arbitrary height of 150 km. Assuming the electron density profile perturbed by the bubble, the 6300 A intensity was calculated for various latitudes arbitrarily taken within the photometer scanning range. The calculated airglow results show that, as the bubble moves upward, the disturbance in the airglow intensity propagates from north to south, in agreement with observed results.

62224 **(INPE—2202-PRE/011) Ionospheric disturbances propagating eastward in a low latitude detected by VHF polarimeters.** Kantor, I.J.; Abdu, M.A.; Batista, I.S. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Aug 1981. 16p. (In several languages). NTIS, PC A02/MF A01.

From 33rd reuniao anal da SBPC; Salvador, Brazil (Jul 1981).

Simultaneous measurements of the total electron content (TEC) through observations of the Faraday rotation angle of vhf signals transmitted by the GOES-1 geostationary satellite, using polarimeters located at Sao Jose dos Campos geographic coordinates (23 deg S, 46 deg W) and Cachoeira Paulista geographic coordinates (23 deg S, 45 deg W), show disurbances in TEC propagating eastward. These disturbances occur especially in the period between sunset and midnight and are associated with spread F as detected in the Cachoeira Paulista ionograms. Statistics of these events, their velocities and their association with equatorial spread F are presented.

62225 **(INPE—2237-PRE/024) Differential behaviour of the equatorial ionospheres on the eastern and western coasts of the South American continent.** Kane, R.P. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Oct 1981. 11p. NTIS, PC A02/MF A01.

A comparison of the daily variation patterns of the geomagnetic field components H, Z, D and the ionospheric F sub 0 F sub 2, at the equatorial locations Huancayo (12 degrees S, 75 degrees W, dip + 1.9 degrees) on the west coast and Eusebio, Fortaleza (4 degrees S, 39 degrees W, dip - 3.5 degrees) on the east coast of the South American continent, shows that the equatorial electrojet and the associated fountain effect are weaker on the east coast.

62226 **(NASA-CR—165098) Dynamics of magnetosphere-ionosphere coupling including turbulent transport.** Lysak, R.L.; Dum, C.T. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching (Germany, F.R.)). 1982. 4p. NTIS, PC A02/MF A01.

A two dimensional two-fluid MHD model including anomalous resistivity was used to investigate the dynamics of magnetosphere-ionosphere coupling. When a field-aligned current is generated on auroral field lines, the disturbance propagates towards the ionosphere in the form of a kinetic Alfven wave. When the current exceeds a critical value, microscopic turbulence is produced, which modifies the propagation of the Alfven wave. This process is modeled by a nonlinear collision frequency, which increases with the excess of the drift velocity over the critical value. Turbulence leads to absorption and reflection of the Alfven wave, partially decoupling the generator from the ionosphere. The approach to a steady-state is strongly dependent on the presence or absence of the turbulence. The current is self-limiting, since a current in excess of critical causes a diffusion of the magnetic field perturbation and a reduction of current.

62227 **(NASA-CR—165113) Double layers on auroral field lines.** Hudson, M.K.; Lotko, W.; Witt, E. (California Univ., Berkeley (USA)). 1982. 22p. NTIS, PC A02/MF A01.

Time-stationary solutions to the Vlasov-Poisson equation for ion holes and double layers were examined along with particle simulations which pertain to recent observations of small amplitude (e phi)/t sub e approx. 1 electric field structures on auroral field lines. Both the time-stationary analysis and the simulations suggest that double layers evolve from holes in ion phase space when their amplitude reaches (e phi)/t sub e approx. 1. Multiple small amplitude double layers which are seen in long simulation systems and are seen to propagate past spacecraft may account for the acceleration of plasma sheet electrons to produce the discrete aurora.

62228 **(NASA-CR—165118) Plasma and electric field boundaries at high and low altitudes on July 29, 1977.** Fennell, J.F.; Johnson, R.G.; Young, D.T.; Torbert, R.B. (Aerospace Corp., El Segundo, CA (USA)). Jan 1982. 46p. NTIS, PC A03/MF A01.

Hot plasma observations at high and low altitudes were compared. The plasma ion composition at high altitudes outside the plasmasphere was 0+. Heavy ions were also observed at low altitudes outside the plasmasphere. It is shown that at times these ions are found well below the plasmapause inside the plasmasphere. Comparisons of the low altitude plasma and dc electric fields show that the outer limits of the plasmasphere is not always corotating at the low L-shells. The corotation boundary, the estimated plasmapause boundary at the boundary of the inner edge of plasma sheet ions were at the same position. The inner edge of plasma sheet electrons is observed at higher latitudes than the plasmasphere boundary during disturbed times. The inner edge of the plasma sheaths shows a strong dawn to dusk asymmetry. At the same time the inner edge of the ring current and plasma sheath also moves to high latitudes reflecting an apparent inflation of the magnetosphere.

62229 **(NASA-CR—168508) Numerical simulation of the interaction of the plasma sheet with the lobes of the earth's magnetotail.** Swift, D.W. (Alaska Univ., Fairbanks (USA)). 1982. 46p. NTIS, PC A03/MF A01.

Codes involving one and two spatial dimensions and three velocity dimensions were used to model the Earth's magnetotail. It was shown that the magnetotail can become inflated as a consequence of low energy plasma convection toward the neutral plane. The computer study exhibits a conversion of both magnetic field energy and of energy supplied by the convection electric field into particle energy. The numerical simulations suggest that much of the magnetotail substorm morphology may be a simple consequence of an increase, followed by a decrease, in the convection electric field, without the requirement of any magnetospheric size scale plasma instability or other disruptive processes. It is also concluded that the presence of the convection electric field and a continuing replenishment of low energy particles in the magnetotail are both necessary for maintenance of the magnetotail.

62230 **(REPT—658) Plasma ion composition in the high-latitude magnetospheric boundary layer according to Prognoz-7 data.** Dubinin, E.M.; Zakharov, A.V. (AN SSSR, Moscow). 1981. 23p. AN SSSR, Moscow.

A mass analysis of the plasma in the high-latitude boundary layer (the plasma mantle) was made. Direct evidence was obtained that the ionosphere, similar to the solar wind, is a source of the plasmas in this region, filling it by ions (H+) and (O+). The number density of ionospheric ions (O+) in the mantle is usually several percent. During the disturbed periods it increases up to several tens of percent. Energies of these ions are several keV. The content of ions (O+) is usually much higher than that of ions (He+) that indicates the ionospheric but not plasmasphere origin of them. The mechanism of ion acceleration is probably such that it ensures an equal energy to all the ions independently or their mass. The content of ions (O+) correlates positively with the magnetospheric activity level.

62231 **ULF pulsations in the magnetosphere.** Southwood, D.J. (ed.). Tokyo, Japan; Center for Academic Publications (1981). 147p. (CONF-791231—Exc.). Kluwer Boston Inc., 190 Old Derby Street, Hingham, MA 02043.

From 17. General Assembly of the International Union of Geodesy and Geophysics; Canberra, Australia (Dec 1979).

Topics covered in the conference include: latitudinal and longitudinal variation of Pc 4,5 pulsations and implications regarding source mechanisms; observations of Pc pulsations in the magnetosphere, satellite-ground correlation; multistate observation of geomagnetic pulsations; substorm associated micropulsations at synchronous orbit; low frequency pulsation generation by energetic particles; solar wind control of daytime, midperiod geomagnetic pulsations; pulsation structure in the ionosphere derived from auroral radar data; damping and coupling of long-period hydromagnetic waves by the ionosphere; the rotation of hydromagnetic waves by the ionosphere. (GHT)

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REFER ALSO TO CITATION(S) 61028, 62307

62232 **(CONF-820853—2) Multiphoton ionization and third-harmonic generation in atoms and molecules.** Miller, J.C.; Compton, R.N. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01. Order Number DE82020822.

From NATO conference on photophysics and photochemistry in the vacuum ultraviolet; Lake Geneva, WI, USA (15 Aug 1982).

Portions of document are illegible.

We will discuss recent experiments on multiphoton ionization and third-harmonic generation in rare gases and small molecules using focused laser power densities of 10^9 to 10^{11} W/cm^2. Also, some elementary experiments using vacuum ultraviolet light generated by frequency tripling in xenon and krypton will be described. These experiments include absorption and ionization studies using vacuum ultraviolet radiation as well as two-photon ionization using one vacuum ultraviolet photon and one laser photon.

62233 **(CONF-820866—2) Fragmentation of saturated perfluorocarbon gas dielectrics under low-energy-electron impact.** Spyrou, S.M.; Sauers, I.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE82020898.

From 7. international conference on gas discharges and their applications; London, UK (31 Aug 1982).

Portions of document are illegible.

We have proposed earlier the use of perfluorocarbons (PFCs) in combination with other gases for application as insulators in high voltage equipment. The potential use of these compounds requires knowledge of the effects resulting from electron impact in the 0 to 10 eV energy range (a region in which the preponderance of electron energies lie prior to breakdown). Electrons in this energy range attach to molecules either nondissociatively ($e + AX \rightarrow AX^-$) or dissociatively ($e + AX \rightarrow A^- + X$). The stability of the molecule toward low-energy electrons depends on which mode of attachment predominates. We have studied previously a number of cyclic and unsaturated PFCs of dielectric interest. Saturated perfluoroalkanes, having the form n-C/sub N/F/sub 2N + 2/ with N = 3 to 6, are also attractive for this purpose (C_3F_8 and n-C_4F_{10} for example, have dc uniform breakdown strengths of, respectively, 90 and 130% that of SF_6). We have, thus, undertaken a systematic study of these compounds using the electron swarm and the electron beam (by time-of-flight mass spectrometry) methods. The results obtained with the latter method are reported and discussed. Results obtained by the former method have been reported earlier.

62234 **(DOE/ER/10618—7) Multiconfiguration Hartree-Fock Breit-Pauli results for the 2p ^{2}P/sub 1/2/ - 2p ^{2}P/sub 3/2/ E2 and M1 transitions.** Fischer, C.F. (Vanderbilt Univ., Nashville, TN (USA)). 1982. Contract AS05-80ER10618. 2p. (CONF-820749—1). NTIS, PC A02/MF A01. Order Number DE82021831.

From 14. conference of the European Group for Atomic Spectroscopy; Liege, Belgium (27 Jul 1982).

Some forbidden transitions become possible through the fine structure splitting of an LS term into a series of J levels. Examples are the E2 and M1 transition between the 2p ^{2}P/sub 1/2/ and 2p ^{2}P/sub 3/2/ levels in the boron sequence. In the non-relativistic approximation, these levels are degenerate and there is a strong interaction between the $2s^22p$ and $2p^3$ ^{2}P configurations, indicating important correlation efforts. Thus the theoretical determination of the fine structure splitting provides a sensitive test for a computational method. The MCHF method has been extended to include the relativistic corrections in the Breit-Pauli approximation. An MCHF-BP calculation proceeds in two stages. In the first, a non-relativistic MCHF calculation is performed to determine an orbital basis, whereas in the second the Breit-Pauli interaction matrix is diagonalized. At present the orbit-orbit interactions are neglected. Calculations have been performed with this method for 2p ^{2}P/sub 1/2/ - 2p ^{2}P/sub 3/2/ E2 and M1 transitions of the boron se-

quence. In order to study the effect of correlation outside the n = 2 complex, two sets of calculations were performed. In the first, the radial orbitals were determined for an MCHF calculation for ($2s^2 2p$, $2p^3$) ^2P and the Breit-Pauli diagonalization was over the set of four configuration states, ($2s^2 2p$, $2p^3$ ^3P, $2p^3$ ^2D and $2p^3$ ^4S). In the second, the MCHF calculation was for [$2s^2 2p$, $2p^3$, $2p^2(^1S)3p$, $2s^2 4p$, $2s2p(^1,^3P)$ 3d, $2s3s(^3S)$ 2p] ^2P and the Breit-Pauli diagonalization included twenty ^2P configuration states, as well as $2p^3$ ^2D and $2p^3$ ^4S, for a total of twenty-two configuration states.

62235 **(DOE/ER/10618—8) BeII** revisited.** Fischer, C.F. (Vanderbilt Univ., Nashville, TN (USA)). 1982. Contract AS05-80ER10618. 2p. (CONF-820868—1). NTIS, PC A02/MF A01. Order Number DE82021632.

From International conference on atomic physics; Gothenburg, Sweden (2 Aug 1982).

Doubly excited 1s2snl and 1s2pnl quartet states of BeII** are readily populated in beam-foil experiments and line-rich spectra have been obtained covering 600 to 5500 A wavelength range. In spite of several theoretical calculations a substantial number of observed lines have not been identified. The quartet system in BeII is an intersting one from a theoretical point of view. Three electron systems are simple enough that a fairly high level of accuracy is attainable without the calculations becoming horrendous. The important correlation effects are between the outer two electrons and, to a good approximation, the three-electrons system may be treated as a two-electron system outside a 1s-core. The multi-configuration Hartree-Fock (MCHF) method has been used successfully in a number of studies. Programs are under development that take into account the non-orthogonality of orbitals in the initial and final state, and allow for some non-orthogonal orbitals in a wavefunction expansion. LS dependent relativistic effects are also included. A study of BeII** was undertaken to evaluate the MCHF techniques being developed and to assit in the identification of observed lines. Most of the earlier calculations concentrated on the lower-lying levels. In this work particular attention was given to the more highly-excited states, though calculations for lower-lying states had to be repeated in order to predict life-times.

62236 **(EFI—468(10)-81) Orientation dependence of bremsstrahlung in diamond crystals.** Agan'yants, A.O.; Vartanov, Yu.A.; Vartapetyan, G.A.; Marukyan, G.O. (Erevanskij Fizicheskij Inst. (USSR)). 1981. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702692.

The movement of 4.7 GeV electrons under small angles to crystal axes and planes is followed by significant enchancement of radiation in the low-energy part of spectrum. The yield of γ-quanta of the spectrum high-energy part decreases in a rather wide range of electron inlet angles 0 - 1 mrad with respect to the axis <110>.

62237 **(IPF—80-11) Energy analysis of fast ions from plasma focus discharges.** Mozer, A. (Stuttgart Univ. (TH) (Germany, F.R.)). Sep 1980. 120p. (In several languages). NTIS, PC A06/MF A01.

A Thomson parabola spectrometer was developed and used for energy and mass analysis of the fast ions emitted by a plasma focus. The design of the spectrometer, the detection system using cellulose nitrate films error analysis, and the calibration and test procedure are described. Besides deuterons, results reveal the presence in the emitted flux of highly ionized impurity ions which attain energies up to 18 MeV. Their energy distribution is consistent with acceleration in an electric field reaching 4 MV/mm. The deuteron distribution is shown to depend on the filling pressure. Besides use as an intense neutron source, the plasma focus can be used as a heavy ion accelerator provided the heavy ion yield can be increased. (ESA)

62238 **(MPIS—4/1981) Investigations of nonreactive vibrational and rotational excitation in small, potentially reactive ion molecule systems at energies below 6eV.** Tepperwien, W. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). Apr 1981. 93p. (In German). NTIS, PC A05/MF A01.

The excitation of vibrational and rotational degree of freedom of molecules during ionic collision, a chemical elementary process related to chemical kinetics, is discussed. Molecular radiation experiments with single collisions were performed. Nonreactive vibrational and rotational excitation with small potential reactive ion molecule systems were investigated. Mostly higher vibrational changes take place. It is found that the hydrogen molecules are vibrationally excited by the collision, while the rotational degree of freedom remains relaxed.

62239 **(MPIS—23/1980) Potential determination of the system sodium (3 2p) plus mercury (6 1s) by measuring and analyzing the rainbow scattering in the superthermal energy domain between 0.3 and 3.2ev.** Huewel, L. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). Dec 1980. 122p. (In German). NTIS, PC A06/MF A01.

The differential scattering cross section of the collision system Na (3 2 P) + Hg (6 1S) was determined, using rainbow oscillations. Electronically laser excited Na atoms were scattered by Hg and fluorescence was observed. The experimental setup consists basically of two (Na and Hg) atomic beams and an out of plane detection system. With a fast Na atomic beam, capable of reaching velocities above 5000 m/sec and providing collision energies of 3eV. Two well separated rainbow oscillatory systems were demonstrated in the differential scattering cross section. Both rainbow systems show strong amplitude dependence on the laser light polarization state. (ESA)

62240 **(OEFZS—4105) Metallic glasses of the type Fe80B17X3. A SIMS study.** Riedel, M.; Gnaser, H.; Ruedenauer, F.G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Physik). Aug 1981. 43p. (PH—326/81). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702691.

Absolute and relative practical sensitivities for Osub2sup+ - bombardement of 14 elements, present as a 3% admixture in a Fe80B17X3 metallic glass matrix, were determined by SIMS. The variation of sensitivity data between elements is similar to that found for pure element samples. The 3% admixture causes a small but statistically significant matrix effect on the matrix elements Fe and B. Comparison with yield data of the same minor impurity elements in other matrices (stainless steel, silicon) shows, that sensitivities in different matrices are within 30% for most elements, indicating the possibility of transferring relative sensitivity factor data determined on metallic glasses to other Fe-based alloys and thereby obtaining a semi- quantitative analysis.

62241 **(WIS-Ph—81/61) Geometric content of the interacting boson model for molecular spectra. A testground for the nuclear IBM.** Levit, S.; Smilansky, U. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Dec 1981. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702532.

The recently proposed algebraic model for collective spectra of diatomic molecules is analysed in terms of conventional geometrical degrees of freedom. We present a mapping of the algebraic Hamiltonian onto an exactly solvable geometrical Hamiltonian with the Morse potential. This mapping explains the success of the algebraic model in reproducing the low lying part of molecular spectra. At the same time the mapping shows that the expression for the dipole transition operator in terms of boson operators differs from the simplest IBM expression and in general must include many-body boson terms. The study also provides an insight into the problem of possible interpretations of the bosons in the nuclear IBM.

62242 **Effect of a magnetic filter on the formation and deposition of high-Z impurities in a multicusp ion source.** Ehlers, K.W.; Leung, K.N.; Pincosy, P.A.; Vella, M.C. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **41**: No. 6, 517-519(15 Sep 1982). Contract AC03-76SF00098.

The presence of a magnetic filter in a multicusp ion source reduces the transport of tungsten to the extractor region by forming a uniform plasma potential region in the source chamber. Because of the reduced numbers of primary electrons in the extraction chamber, the plasma grid floats near the plasma potential and this

reduces the amount of impurity ions formed from sputtered grid material.

62243 **Effects of collisional relaxation on spectral functions in the quasiperiodic and chaotic regimes.** Koszykowski, M.L.; Liu, W.; Noid, D.W. (Sandia National Laboratories, Livermore, California 94550). *Journal of Chemical Physics;* **77**: No. 6, 2836-2840(15 Sep 1982).

A line shape formalism is derived classically which considers molecules undergoing both collisional and intramolecular relaxation. Results for a model system demonstrate a significant effect on the line shapes when chaos sets in and the intramolecular relaxation becomes important. An experiment on polyatomic molecules is proposed and should isolate the two effects.

62244 **Incomplete basis-set problem. V. Application of CIBS to many-electron systems.** McDowell, K.; Lewis, L. (Department of Chemistry and Geology, Clemson University, Clemson, South Carolina 29631). *Journal of Chemical Physics;* **77**: No. 6, 3068-3080(15 Sep 1982).

Five versions of CIBS (corrections to an incomplete basis set) theory are used to compute first and second corrections to Roothaan—Hartree—Fock energies via expansion of a given basis set. Version one is an order by order perturbation approximation which neglects virtual orbitals; version two is a full CIBS expansion which neglects virtual orbitals; version three is an order by order perturbation approximation which includes virtual orbitals; version four is a full CIBS expansion which includes orthogonalization to virtual orbitals but neglects virtual orbital coupling terms; and version five is a full CIBS expansion with inclusion of coupling to virtual orbitals. Results are presented for the atomic and molecular systems He, Be, H_3, LiH, Li_3, and H_2O. Version five is shown to produce a corrected Hartree—Fock energy which is essentially in agreement with a comparable SCF result using the same expanded basis set. Versions one through four yield varying degrees of agreement; however, it is evident that the effect of the virtual orbitals must be included. From the results, CIBS version five is shown to be a viable quantitative procedure which can be used to expand or to study the use of basis sets in quantum chemistry.

62245 **Kinetic theory calculation of the orientational correlation time of a rotorlike molecule in a dense fluid of spheres.** Evans, G.T.; Cole, R.G.; Hoffman, D.K. (Department of Chemistry, Oregon State University, Corvallis, Oregon 97331). *Journal of Chemical Physics;* **77**: No. 6, 3209-3220(15 Sep 1982).

The collective and single-particle orientational correlation times are calculated using Boltzmann—Enskog kinetic theory for N rotorlike molecules in a bath of spheres. By assuming that the rotors and bath are hard convex bodies, the collision integrals can be reduced exactly to one- and two-dimensional integrals, which are then readily amenable to numerical quadrature. The calculated correlation times depend on density and temperature in the same way as do the rough hard sphere results. However, the particle shape anisotropy plays the role of the roughness parameters. Comparison of the collective and single-particle orientational correlation times with experiment (including molecular dynamics) indicates that the kinetic theory consistently neglects part of the frictional drag. In all cases studied, the calculated times were a factor of 2 to 4 below the experimental values.

62246 **Theoretical studies of ion neutralization: A tight binding linear chain model.** McDowell, H.K. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **77**: No. 6, 3263-3274(15 Sep 1982).

A tight binding semi-infinite chain is used to model the neutralization of ions impinging on a solid surface. Starting from the equations of motion for the appropriate annihilation operators of site-centered orbitals, two approaches to computing the neutralization probability are developed. The first approach is based on using the well-known molecular orbitals of such a chain. We conclude that this method, in general, is dependent on one's ability to obtain molecular orbitals for an extended solid system. The second approach developed is based on a Langevin-type model in that we separate out a primary zone where the collision of the ion with the surface occurs and treat the remainder of the chain by using a memory kernel. We conclude that this method offers hope for treating realistic systems. Numerical computations are carried out using both approaches for specific choices of the parameters of the model. Exact agreement between the methods is obtained. In addition, the neutralization probability is found to oscillate as a function of the incident ion energy. This behavior is analyzed in some detail as a function of the parameters of the model.

62247 **Pinch effect for intense, magnetized, non-neutral electron beams.** Adler, R.J.; Miller, R.B. (Mission Research Corporation, 1720 Randolph Rd. SE, Albuquerque, New Mexico 87106). *Journal of Applied Physics;* **53**: No. 9, 6015-6017(Sep 1982).

An intense, magnetized, non-neutral electron beam has been observed to pinch as it impinges on a witness foil. A simple theoretical model of the effect is presented and compared with the experiment. These results are of particular importance for beams used to produce gamma rays and when beam parameters are measured using a grounded probe.

62248 **Reflection of 32—2000 eV deuterium from carbon.** Braun, M.; Thomas, E.W. (Research Institute of Physics, Association Euratom-Studsvik, S-104 05 Stockholm, Sweden). *Journal of Applied Physics;* **53**: No. 9, 6446-6449(Sep 1982).

Reflection of deuterium from carbon is measured by a technique based on the rise of partial pressure caused by the reflected particles. Data are presented for 32—2000 eV per deuteron incident energies and as a function of angle of incidence. The data are consistent with previous determinations at energies above 1000 eV. A systematic difference in energy dependence is found when the measurements for reflection of deuterium are compared on a reduced energy scale with MARLOWE computer simulations of hydrogen reflection.

62249 **Further study on a magnetically filtered multicusp ion source.** Ehlers, K.W.; Leung, K.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **53**: No. 9, 1423-1428(Sep 1982). Contract W-7405-ENG-48.

An optimized permanent magnet filter geometry has been determined for a multicusp ion source operated with hydrogen gas. By applying a negative bias potential to the plasma grid, energetic secondary electrons are produced which can generate molecular hydrogen ions in the extraction chamber and thus reduce the H^+ ion fraction in the extracted beam. Both the atomic species percentage and the ion current density can be improved by the addition of 16-eV electrons into the extraction chamber. It is also observed that once started, the discharge can be maintained with only the extraction chamber and the plasma grid acting as the anode. Thus the total discharge current can pass through the filter in the form of cold electrons.

62250 **Increasing the efficiency of a multicusp ion source.** Ehlers, K.W.; Leung, K.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **53**: No. 9, 1429-1433(Sep 1982). Contract AC03-76SF00098.

The characteristics of a multicusp ion source are compared for two types of permanent magnets. A technique for reducing the ion loss to the regions between the line cusps is described. The effect of this magneto-electrostatic containment scheme is shown to increase the overall efficiency of the ion source.

62251 **Measurement of the spin polarization of an optically pumped ensemble of He (2^3S) atoms.** Cheng, C.; Giberson, K.W.; Harrison, A.R.; Tittel, F.K.; Dunning, F.B.; Walters, G.K. (Department of Physics and The Rice Quantum Institute, Rice University, Houston, Texas 77251). *Review of Scientific Instruments;* **53**: No. 9, 1434-1437(Sep 1982).

A technique is described that enables simple, direct determination of the spin polarization of an optically pumped ensemble of He (2^3S) atoms. The polarization is obtained from measurements of

the attenuation of the circularly polarized output of a color-center laser tuned to the 1.08 μm He ($2^3S_1 \rightarrow 2^3P_0$) transition.

62252 **Radially uniform electron source.** McComas, D.; Bame, S.J. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **53**: No. 9, 1490-1491(Sep 1982). Contract W-7405-ENG-36.

A thermionic electron source capable of producing uniform count rates in a number of channel electron multipliers simultaneously was required for conditioning multipliers for an extended space mission. It was found that a straight tungsten filament in the center of a cylindrically symmetric geometry surrounded by an array of multipliers emits a radially asymmetric distribution of electrons that changes with time. A source was developed which successfully produces a time-independent radially uniform distribution of electrons by moving the filament out of the direct line of sight and replacing it with a centrally located electron "cloud."

62253 **Relativistic many-body theory of atomic transitions. The relativistic equation-of-motion approach.** Huang, K. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *A: General Physics;* **26**: No. 2, 734-739(Aug 1982). Contract W-31-109-ENG-38.

An equation-of-motion approach is used to develop the relativistic many-body theory of atomic transitions. The relativistic equations of motion for transition matrices are formulated with the use of techniques of quantum-field theory. To reduce the equations of motion to a tractable form which is appropriate for numerical calculations, a graphical method to resolve the complication arising from the antisymmetrization and angular-momentum coupling is employed. The relativistic equation-of-motion method allows an ab initio treatment of correlation and relativistic effects in both closed- and open-shell many-body systems. A special case of the present formulation reduces to the relativistic random-phase approximation.

62254 **Autoionizing resonance profiles in the photoelectron spectra of atomic cadmium.** Kobrin, P.H.; Becker, U.; Southworth, S.; Truesdale, C.M.; Lindle, D.W.; Shirley, D.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **26**: No. 2, 842-856(Aug 1982).

Photoelectron spectra have been taken of atomic Cd with synchrotron radiation between 19 and 27 eV using the double-angle time-of-flight method. Dramatically different energy dependences of the partial cross sections for producing the lowest ^{2}D/sub 5/2/, ^{2}D/sub 3/2/, ^{2}S/sub 1/2/, and ^{2}P/sub 3/2,1/2/ ionic states of Cd^+ were observed for photon energies in the neighborhood of the $[4d^9(5s5p\ ^3P)]^2$P/sub 3/2/6s $^1P_1$ autoionizing resonance at 588 A. Partial decay widths from the excited resonance state have been determined by fitting the resonance line shapes to theoretical expressions for the partial cross sections. Resonance profiles in the photoelectron angular-distribution asymmetry parameter for the ^{2}D/sub 5/2/ and ^{2}D/sub 3/2/ channels are also reported. The ^{2}P/sub 3/2,1/2/ satellite is found to decrease slightly relative to the ^{2}S/sub 1/2/ main line in the 19—25-eV range. Three new satellite peaks have been detected with intensities enhanced by autoionization.

62255 **Charge changing cross sections for Pb and Xe ions at velocities up to 4 x 10^9 cm/sec.** Alonso, J.; Gould, H. (Accelerator and Fusion Research Division, Building 64 and Materials and Molecular Research Division, Building 71, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **26**: No. 2, 1134-1137(Aug 1982).

We have made a comprehensive study of charge-changing cross sections in N_2 of Pb and Xe ions at velocities near 4 x 10^9 cm/sec. We determine the velocity, ionization state, and Z dependence of the capture and ionization cross sections and make an extensive comparison with theory.

62256 **Two-atom model in enhanced ion backscattering near 180° scattering angles.** Oen, O.S. (Oak Ridge National Lab., TN (USA). Solid State Div.). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 87-91(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

The recent discovery by Pronko et al. of an unusual enhancement of the yield of ions backscattered through angles close to 180° from the near surface regions of solids is investigated using a two-atom scattering model. The model predicts an enhancement effect in amorphous solids whose physical origin arises from the tolerance of path for those ions whose inward and outward trajectories lie in the vicinity of the critical impact parameter. Predictions are given of the dependence of the yield enhancement on the following parameters: ion energy, backscattering depth, exit angle, scattering potential, atomic numbers of projectile and target, and atomic density of target.

62257 **Possible applications of the steering of charged particles by bent single crystals.** Carrigan, R.A. Jr. (Fermi National Accelerator Lab., Batavia, IL (USA)); Gibson, W.M.; Sun, C.R. (State Univ. of New York, Albany (USA)); Tsyganov, E.N. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 205-208(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

This article reviews some aspects of the steering of charged particles using channeling in bent crystals. Crystal angular and spatial acceptance, deflection, dechanneling, and radiation damage are discussed. Examples of possible bent crystal applications are presented including extraction, beam transport, focusing, the possibility of charm particle separated beams, and magnetic moment determination.

62258 **Monte Carlo calculations of channeling radiation and comparison with experiment.** Bloom, S.D.; Berman, B.L.; Hamilton, D.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.); Alguard, M.J. (Measurex Corp., Cupertino, CA (USA)); Barrett, J.H.; Datz, S. (Oak Ridge National Lab., TN (USA)); Pantell, R.H.; Swent, R.L. (Stanford Univ., CA (USA). Dept. of Electrical Engineering). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 229-233(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Results of classical Monte Carlo calculations are presented for the radiation produced by ultra-relativistic positrons incident in a direction parallel to the (110) plane of Si in the energy range 30-100 MeV. The results all show the characteristic CR (channeling radiation) peak in the energy range 20-100 keV. Plots of the centroid energies, widths, and relative total yields of the CR peaks as a function of energy show the power law dependences of $\gamma^{1.45}$, $\gamma^{1.7}$, and $\gamma^{2.5}$ with uncertainties in the exponents of +-0.05, +-0.3, and +-0.5, respectively. Agreement with experimental data is good for the centroid energies but only rough for the widths. Adequate experimental data for verifying the yield dependence on γ does not yet exist. The slight departure from a pure $\gamma^{1.5}$ dependence, in the case of the centroid energies, can be accounted for by the effects of an harmonicity.

62259 **Collisional effects in the passage of fast molecular ions through thin foils.** Gemmell, D.S. (Argonne National Lab., IL (USA). Physics Div.). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 255-267(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Some recent developments in studies on the interactions of fast molecular-ion beams with thin foil targets are discussed.

62260 **Ion-source dependence of the distributions of internuclear separations in 2 MeV HeH^+ beams.** Kanter, E.P.; Gemmell, D.S.; Plesser, I.; Vager, Z. (Argonne National Lab., IL (USA). Physics Div.). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 307-310(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Experiments involving the use of MeV molecular-ion beams have yielded new information on atomic collisions in solids. A central part of the analyses of such experiments is a knowledge of the distribution of internuclear separations contained in the incident beam. In an attempt to determine how these distributions depend on ion-source gas conditions, we have studied foil-induced dissociations of H_3^+, H_3^+, HeH^+ and OH_3^+ ions. Although changes of ion-source gas compositions and pressure were found to have no measurable influence on the vibrational state populations of the beams reaching our target, for HeH^+ we found that beams produced in our rf source were vibrationally 'hotter' than beams produced in a duoplasmatron. This was also seen in studies of neutral fragments and transmitted molecules.

62261 **Resonant coherent excitation of fast heavy ions in crystals. Pt. 7. Projectile excitation.** Moak, C.D.; Biggerstaff, J.A.; Crawford, O.H.; Dittner, P.F.; Datz, S.; Gomez del Campo, J.; Hvelplund, P.; Knudsen, H.; Krause, H.F.; Miller, P.D. (Oak Ridge National Lab., TN (USA)). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 327-336(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Hydrogen-like ions of B, C, N, O and F and helium-like ions of N, O and F have been shown to exhibit resonant coherent excitation from their n = 1 to their n = 2 states, caused by periodic electric potential oscillations which occur as the ion moves through axial or planar channels of a thin crystal of Au. The resonance velocities of the ions exhibit shifts and splittings which are the result of the crystal fields acting upon the one-, or two-electron ions. Comparisons with theory show fairly good agreement except for certain weak resonance components which do not appear or appear at unexpected values of the resonance velocity.

62262 **Convoy electron production in heavy ion-solid collisions. Pt. 8. Electron emission.** Sellin, I.A.; Breinig, M. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)); Brandt, W. (New York Univ., NY (USA)); Laubert, R. (East Carolina Univ., Greenville, NC (USA)). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 395-404(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

The properties of the sharp upsilonsub(e) approx. equal to upsilon cusps observed in the velocity spectrum of convoy electrons (upsilonsub(e)) ejected in heavy ion-solid collisions in the ion velocity range (upsilon) 6-18 a.u. are compared to the properties of analogous cusps observed in binary electron capture to the continuum (ECC) and electron loss to the continuum (ELC) collisions in gases. Apart from a skew toward upsilonsub(e) > upsilon, the upsilon-independent convoy distributions observed are very similar to those for ELC and the cusp widths are the same in both cases. While the shape of convoy peaks is approximately independent of projectile Z, upsilon, and of target material, yields in polycrystalline targets (C, Al, Ag, Au) exhibit a strong dependence on Z and upsilon. Coincidence experiments in which convoy electrons are allocated according to emergent ion charge-state qsub(c) show a surprising independence of qsub(e), mirroring the unweighted statistical emergent charge-state fraction. Coincidence experiments on Osup(6+,7+,8+) ions traversing <110> and <100> channels in Au show a strong yield suppression and a dependence of yield on the channel chosen. Interpretation of these observations, comparisons to convoy production studies using protons, and a discussion of remaining puzzles is given. The history of ECC, ELC, and 'wake-riding' models of convoy electron production is also reviewed.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 62389, 62390

62263 **(ITF—82-75P) Balescu-Lenard equation for semi-bounded plasma.** Zagorodnii, A.G.; Usenko, A.S.; Yakimenko, I.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Jun 1982. 40p. (In Russian). Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR.

On the basis of the general theory of electromagnetic fluctuation in a plasma the Balescu-Lenard kinetic equation has been obtained for many-component systems of charged particles with a specularly-reflecting boundary. The explicit form of Focker-Planck coefficients for semi-bounded plasma has been found. The density profiles of equilibrium distribution has been calculated.

62264 **(UCID—19546) Numerical treatment of interior boundary conditions of the Onsager equation.** Viecelli, J. (Lawrence Livermore National Lab., CA (USA)). 2 Sep 1982. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01. Order Number DE82021012.

It has been shown that the extra condition needed to fix the stream function on an interior boundary in an incompressible liquid flow is that the integral of the pressure gradient along any path enclosing the boundary should vanish. More recently this constraint has been used to solve for a few special cases of compressible centrifuge flows. One way in which this constraint can be easily incorporated in a numerical scheme for solving the Onsager equation for the gas flow in a centrifuge is described.

62265 **Excess pressure drops in entrance flows.** Vrentas, J.S.; Duda, J.L.; Hong, S. (Department of Chemical Engineering, The Pennsylvania State University, University Park, Pennsylvania 16802). *Journal of Rheology;* **26**: No. 4, 347-371(Aug 1982).

New results are presented for the excess pressure drop in the entrance flow of inelastic materials. These predictions demonstrate how shear thinning effects promote higher pressure losses in the entrance geometry. A flow reversibility result, identical to the slow flow reversibility principle for Newtonian materials, is established for the creeping flow of an inelastic fluid.

62266 **Creep of a second-order fluid.** Passman, S.L. (Computational Physics & Mechanics Division II, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Rheology;* **26**: No. 4, 373-385(Aug 1982).

The boundary-value problem associated with flow of a right circular cylinder of a second-order fluid under constant axial stress and lateral pressure is formulated. Closed-form solutions are given. Agreement with creep tests on natural rock salt is noted.

62267 **Homogeneous nucleation in ^{4}He: A corresponding-states analysis.** Sinha, D.N.; Semura, J.S.; Brodie, L.C. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **26**: No. 2, 1048-1061(Aug 1982).

We report homogeneous-nucleation-temperature measurements in liquid ^{4}He over a bath-temperature range 2.31<T/sub b/<4.62 K. These measurements were performed with the use of a transient superheating technique. The nucleation data constitute a demonstration of the quantitative accuracy of the Becker-Doering nucleation theory in describing the first-order transition kinetics in a quantum liquid, such as liquid ^{4}He, in a region far from the critical point. A simple empirical form is presented for estimating the homogeneous nucleation temperatures for any liquid with a spherically symmetric interatomic potential. The ^{4}He data are compared with nucleation data for Ar, Kr, Xe, and H; theoretical predictions for ^{3}He are given in terms of reduced quantities. It is shown that the nucleation data for both quantum and classical liquids obey a quantum law of corresponding states (QCS). On the basis of this QCS analysis, predictions of homogeneous nucleation temperatures are made for hydrogen isotopes such as HD, DT, HT, and T_2.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 62200

62268 (CERN—82-01, pp 15-23) **What makes the HEPHY run. An introduction to high-energy physics.** Boratav, M. (Paris-6 Univ., 75 (France)). 22 Mar 1982. NTIS (US Sales Only), PC A12/MF A01.

From European hybrid spectrometer workshop on holography and high-resolution techniques; Strasbourg, France (9 Nov 1981).

My aim, in this short report, is to explain to those unfamiliar with high-energy physics, why (and, to some extent, how) experiments are done in our field. I shall try to show how interesting particle physics can be, and why it is worth while to invest so much effort in undertaking more and more complicated experiments - effort on the part of our home institutions in money and facilities, and also on the part of the physicists themselves, whose professional life is generally far from being easy-going.

62269 **International conference on high-energy physics.** Merz, W.J. Thomas, G. (eds.). Lancy, Switzerland; European Physical Society (1981). 351p. European Physical Society, P.O. Box 39-CH 1213, Petit-Lancy 2, Switzerland. Order Number DE82905296.

From International conference on high energy physics; Lisbon, Portugal (9 Jul 1981).

The conference includes sections on lepton physics, hardron physics, phenomenology, theory, instrumentation, and ion-ion collisions. (GHT)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 61924, 61949

62270 (DOE/ER/03023—30) **High-energy physics at Tufts University. Progress report.** (Tufts Univ., Medford, MA (USA)). 31 Jul 1982. Contract AC02-76ER03023. 108p. NTIS, PC A06/MF A01. Order Number DE82020749.

High energy physics research by Tufts University during the period from July 1981 through July 1982 is described. Reports are included from the bubble chamber group, bubble-chamber-photon-group collaborations, the photon group and the theory group. Experiments were performed on neutrino-deuterium interactions, anti-proton-neutron interactions, pion-minus proton interactions, neutrino-deuteron interactions, photoproduction of charmed particles, hadronic production of Chi, shadowing of virtual photons, and high transverse momentum inelastic hadronic reactions. (GHT)

62271 (DOE/ER/03130—T8) **Research program in experimental high-energy physics. Task C. Progress report, January 1, 1982-December 31, 1982.** Lanou, R.E. Jr. (Brown Univ., Providence, RI (USA)). 30 Jul 1982. Contract AC02-76ER03130. 112p. (COO—3130TC-7). D. Order Number DE82019933.

Portions of document are illegible.

An experimental program in strong and electro-weak interaction physics of elementary particles is being carried out using electronic detection techniques. Experiments have been performed or have been proposed utilizing the accelerators of the laboratories at Brookhaven, Fermilab, LAMPF, and SLAC. The experiments described in this report by the Electronic Detector Group include the following: (1) experiments to measure neutrino-electron and other neutral current phenomena, (2) studies for experiments at ISABELLE and the FNAL anti P P Collider, (3) neutrino oscillation experiments at BNL, and (4) development of a muon polarimeter.

62272 (DOE/ER/03244—98) **Hyperon- and antihyperon-nucleon scattering at lear.** Barnes, P.D.; Birien, P.; Bonner, B. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Jun 1982. Contract AC02-76ER03244. 5p. (COO—3244-98; CONF-820635—6). NTIS, PC A02/MF A01. Order Number DE82021914.

From International conference on hypernuclear and kaon physics; Heidelberg, F.R. Germany (20 Jun 1982).

We have proposed to study at LEAR the production of hyperon-antihyperon pairs i.e. the two-body processes: anti pp- → anti YY-, where Y:Λ,Σ, near threshold. Within the momentum range of LEAR the following pair creations are possible: antiΛΛ-, $\Lambda\Sigma_0$ + c.c., anti $\Sigma^+\Sigma^+$, anti $\Sigma^0\Sigma^0$ and anti $\Sigma^-\Sigma^-$. As an example the momentum interval of the anti ΛΛ-pair at the maximum anti p-momentum of 2 GeV/c covers the range 0.4 < p/sub Λ, anti Λ) < 1.6 GeV/c. The yield at the rate of 10^6 anti p/s and a production target of 2.5 mm CH_2 amounts to about 2.10^5 anti ΛΛ-pairs per day, 5.10^4 of these yielding 4 charged decay particles. This rate is sufficiently large to make detailed studies of hyperon-nucleon and hyperon-nuclei interactions feasible. This information is of vital importance for our understanding of the strong interaction.

62273 (DOE/ER/03509—18) **Progress report, July 1, 1981-August 1, 1982.** (Florida State Univ., Tallahassee (USA). Dept. of Physics). 1982. Contract AS05-76ER03509. 78p. (ORO—3509-18). NTIS, PC A05/MF A01. Order Number DE82021935.

Portions of document are illegible.

In the charmed particle studies using the bubble chamber at SLAC, more film was obtained. A measurement of the lifetimes of charmed mesons was published. The cascade experiment at BNL and the double-V experiment at Fermilab both saw great progress in refining data. Both of these efforts are on the verge of publication of results. The douple-phi experiment at Fermilab was run obtaining over three million triggers and a definite phi-phi signal, and advanced by construction efforts on a scintillator array to segment the Cherenkov counter, the signal processor electronics and the drift chambers. Theoretical work is continuing on the predictions of perturbative QCD. Leading and next-to-leading logarithm terms were investigated for deep inelastic Compton scattering. Scaling violations in deep inelastic scattering were analyzed. Calculations have been performed on gluon polarization in quark-gluon elastic scattering. Exclusive decays of J/psi were studied in an analysis to be expanded. Fourth-order QCD corrections to the longitudinal coefficient function in deep-inelastic scattering were calculated and published. A comparison was made between the principle of minimal sensitivity and other schemes for renormalization. Mathematical and physical problems concerning gravitation and general relativity continue to be investigated, especially questions of the possible time dependence of G, the gravitational constant.

62274 (DOE/ER/03539—20) **Experimental investigations in particle physics at intermediate energies. Progress report, December 1, 1981-November 30, 1982.** Auerbach, L.B.; Highland, V.L.; McFarlane, W.K. (Temple Univ., Philadelphia, PA (USA). Dept. of Physics). Aug 1982. Contract AC02-76ER03539. 12p. (COO—3539-20). NTIS, PC A02/MF A01. Order Number DE82021049.

Portions of document are illegible.

The analysis of the pion-beta decay experiment is complete, with an improvement in accuracy of a factor of two over previous work. Preparations for the search for bound states in anti pp at CERN using the LEAR facility are well advanced. The proposal to use the Crystal Box at LAMPF for a new pi-zero-to-three-gamma experiment has been approved. Work on the neutrino experiment proposal (No. 638) at LAMPF has continued. We expect to make some contributions to the proposal for LAMPF II in the coming months.

62275 (DOE/ER/40033—27) **Neutrino charged-current structure functions.** Blair, R.E.; Sciulli, F.J.; Fisk, H.E.; Bodek, A.; Fackler, O.D. (California Inst. of Tech., Pasadena (USA); Columbia Univ., New York (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Rochester Univ., NY (USA); Rockefeller Univ., New York (USA)). 1982. Contract AC02-81ER40033. 11p. (CONF-820675—3). NTIS, PC A02/MF A01. Order Number DE82022009.

From International conference on neutrino physics; Balaton, Hungary (14 Jun 1982).

Charged current total cross sections and structure functions were extracted from neutrino and antineutrino data taken with the Fermilab narrow band beam. The cross section results are σ/sup

nu//E = 0.701 +- 0.004 +- 0.025 x 10^{-38} cm^2/GeV and σ/sup nu-bar//E = 0.350 +- 0.04 +- 0.022 x 10^{-38} cm^2/GeV. The structure functions exhibit scaling violations. A comparison with structure functions obtained in muon scattering experiments indicates a ratio consistent with 18/5 within the systematic errors of both experiments. The structure function function xF_3 is used to test the Gross-Llewellyn Smith sum rule. The data is in agreement with the prediction of 3 for the number of valence quarks on the nucleon.

62276 **(IFVE-OTF—81-155) Relation between power decrease indices for elastic and inclusive cross sections at large momentum transfers.** Troshin, S.M.; Tyurin, N.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1981. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702612.

The relation between power decrease indices of one-particle inclusive cross section at large momentum transfers and fixed angle elastic scattering cross section has been obtained. The power decrease for inclusive cross section is higher than Psub(perpendicular)sup(-4) where Psub(perpendicular) is transverse momentum of bombarding particle. The obtained relation is in agreement with the experimental data.

62277 **(JINR—E-1-81-576) Study of the particle production process using nuclear targets. Pt. 1. Method, experimental indications, working hypothesis, testing procedure.** Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1981. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702534.

Nuclear xenon target has been applied in the study of the particle production process in hadron-nucleon collisions. Attempts are made to show, on the basis of data on hadron-nucleus collisions, that this process proceeds through an intermediate object. Interrelations between the multiplicities of protons emitted in hadron-nucleus collisions and the multiplicities of the pions produced in them provide conclusive information about the particle production mechanism. Simple relations between various characteristics of the particle production process in hadron-nucleus and hadron- nucleon collisions, which are to be tested in hadron-nucleus collision experiments, are the consequence of the assumption that in hadron- nucleon collisions particles are produced through some intermediate object.

62278 **(LUIP—8203) Search for very short-lived particles produced by neutrinos in nuclear emulsion.** Claesson, G.; Ingelman, G.; Soederstroem, K. (Lund Univ. (Sweden)). Mar 1982. 15p. (LUNFD6/NFFK—70151-11(1982)). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702525.

A sample of 22 neutrino induced events in nuclear emulsion have been measured and analysed with a X^2 method to search for secondary vertices, i.e. possible decays of short-lived particles. Production and decay vertices as close as 0.5 μm can, under favourable conditions, be resolved. No candidates for such very short paths were found. We have, however, found a track with a kink which is consistent with a one prong decay.

62279 **Spin transfer measurements for pp→pp at 647 MeV.** McNaughton, M.W.; Bonner, B.E.; Hoffman, E.W.; van Dyck, O.B.; Hollas, C.L.; Riley, P.J.; McNaughton, K.H.; Imai, K.; Toshioka, K.; Roberts, J.; Turpin, S.E.; Aas, B.; Rahbar, A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 249-251(Jul 1982).

Measurements have been made of the spin depolarization parameters D/sub N/N, D/sub S/S, D/sub L/S (27° < or = θ/sub c.m./< or =90°) and the spin transfer parameters K/sub N/N, K/sub S/S, K/sub L/S, (56< or = θ/sub c.m./< or =90°) for pp→pp at 647 MeV. Typical uncertainties are about 0.03 compared with about 0.1 for previous data. Previous data are reviewed. The present data are in agreement with corrected previous data, and are in agreement with Arndt's phase-shift solutions.

62280 **Prompt neutrino sources in DUMAND.** Cline, D. (Fermi National Accelerator Laboratory, Batavia, Ill.; Wisconsin, University, Madison, Wis.). pp 71-80 of DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 2 - UHE interactions, neutrino astronomy. Roberts, A. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

The paper discusses the production of neutrinos that are created through decays in collisions with Pi- and K mesons. Attention is given to charm or short lived particle production cross sections, and to the evidence for large cross section for the production of charm or other particles from cosmic ray experiments.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 62302

62281 **(DESY—81-056) Fermi pseudopotential in higher dimensions.** Grossmann, A.; Wu, T.T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Sep 1981. Contract AC02-76ER03227. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82020282.

The Fermi pseudopotential is generalized from three to five dimensions, and the case of an infinite, uniform, equidistant, linear chain of such pseudopotentials is studied in detail. Similar to the three-dimensional case, zero-width resonances are also present in five dimensions. While this generalization is natural and can be carried through formally when the strength is negative, there are basic changes in the underlying structure. These results in five dimensions also apply in four dimensions.

62282 **(IFVE-OEF—81-93) Measurement of polarization in the $\pi p + p \rightarrow \pi^0 + n$ reaction in the $0 < t < 2 (GeV/c)^2$ range at 40 GeV/c.** Avvakumov, I.A.; Apokin, V.D.; Belikov, N.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1981. 16p. (In Russian). (SERP-E—112). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702617.

The results on measuring polarization in charge exchange reaction $n^- + p \rightarrow \pi^0 + n$ at 40(GeV/c are presented for the 4-momentum transfer range from 0 up to 2 $(GeV/c)^2$. At excitation < 0.4 $GeV/c)^2$ the polarization has a positive sign. In the "crossover" region of π^{+-} elastic scattering a possible minimum in the polarization behaviour has been seen for the first time. The polarization is zero with the statistical accuracy near this point. In the "deep" region of the charge- exchange differential cross-section the polarization has a negative sign. In the $0.6 < t < 1.3$ $(GeV/c)^2$ range the polarization is again positive and in the 1.3 $(GeV/c)^2 < t < 2.0$ $(GeV/c)^2$ indines to change the sign. The presented data are not in agreement with the modern theoretical models.

62283 **(JINR—E-2-81-631) Hadron-nucleus scattering in constituent quark model.** Kopeliovich, B.Z.; Lapidus, L.I.; Vegh, L. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1981. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702614.

The Eignestate method in hadron-nucleus scattering is considered. The method gives a possibility of taking into account for all inelastic screening corrections to elastic scattering and diffraction processes. Eigenfunctions of interaction in constituent quark-parton model are hadron states with the number of slow partons. The two-component approximation is a good approach when the difference in amplitudes of states with the number of slow partons is not equal to zero is negligible. In the two-component approximation the model has two parameters - the weight of the constituent quark active component and the quark-nucleon total cross section. The parameters can be well defined by hadron-nucleus total cross sections. The differential elastic hadron-nucleus cross sections, the real part of the scattering amplitude, the triple pomeron constant and the amplitude of the Ksub(s) regeneration on nuclei are calculated without free parameters in good agreement with the available experimental data.

62284 **(JINR—R-1-81-678) Production cross sections of cumulative πsup(-) mesons in πsup(-)^{12}C interactions at 40 GeV/c as a function of their cumulative number and transverse momentum. Production cross sections of cumulative jets.** Anoshin, A.I.; Baldin, A.M.; Lyubimov, V.B.; Solov'ev, M.I.; Sulejmanov, M.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1981. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702618.

The data on the behaviour of invariant inclusive production cross sections of cumulative π^- mesons in π^- ^{12}C interactions at 40 GeV/c are presented. The dependence of these cross sections and of cumulative jet ones on cumulative number proved to be practically identical. The sharp change of the cross section dependence on transverse momentum squared near the cumulative region boundary is discovered. The experimental results have been obtained by means of the JINR 2 meter propane chamber. Discovered regularities of cumulative particle production are qualitatively well correspond to the quark-parton picture of hard collisions.

62285 **(JINR—R-2-81-197) Role of spin effects in the small angle hadron scattering at high energies.** Goloskokov, S.V.; Kuleshov, S.P.; Selyugin, O.V.; Teplyakov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702615.

The small angle muon-nucleon and nucleon-nucleon scattering amplitudes at high energies are analyzed in terms of the Logunov- Tavchelidze quasipotential approach with account of spin flip. The importance of the hypothesis on existence of smooth local quasipotential with a finite interaction radius is underlined. The hypothesis brings about the eikonal type scattering. At fixed scattering angles the amplitudes with spin flip appear to be of the same order of magnitude as those without spin flip. The eikonal scattering results in the energy dependence of the quasipotentials and the spiral amplitudes being restricted from the top. The spin effects in the small angle range are shown to die out with the growth of energy.

62286 **(PB—82-208570) Decays of heavy quark systems: effects of gluon condensate.** Reinders, L.J.; Rubinstein, H.R.; Yazaki, S. (Science and Engineering Research Council, Chilton (UK). Rutherford Appleton Lab.). 1982. 13p. NTIS, PC A02/MF A01.

The perturbative and nonperturbative contributions to three-point functions are computed to first order in (alpha sub s). The results are applied to the decay (eta sub c) yields 2 gamma, and large corrections are found compared to the nonrelativistic result.

62287 **Spin amplitudes for NN → NΔ.** Silbar, R.R. (Paris-11 Univ., 91 - Orsay (France). Div. de Physique Theorique; Los Alamos National Lab., NM (USA). Theoretical Div.); Lombard, R.J. (Paris-11 Univ., 91 - Orsay (France). Div. de Physique Theorique); Kloet, W.M. (Rutgers - the State Univ., New Brunswick, NJ (USA). Dept. of Physics and Astronomy). *Nuclear Physics* [*Section*] *A;* **381**: No. 3, 381-404(21 Jun 1982).

The scattering amplitude for NN→NΔ is decomposed into sixteen independent spin-space operators Osub(i), where the corresponding coefficients Asub(i) only depend on scattering angle, incoming energy, and the Δ-mass. In addition to the commonly used vector spin-transition matrix, it is necessary to also employ a tensor spin-transition matrix. The Osub(i) can be chosen in two ways, either to facilitate discussion of underlying dynamical mechanisms or to simplify the antisymmetrization with respect to the initial nucleons. Relations between the Asub(i) (THETA) and the (LSJ) partial-wave amplitudes are given. We evaluate the Asub(i) using partial-wave amplitudes calculated elsewhere in a unitary three-body model with one-pion-exchange driving terms. Many amplitudes are of competing importance after antisymmetrization, and they are strongly dependent upon incident energy and Δ invariant mass.

62288 **Frozen and broken color: A matrix Schroedinger equation in the semiclassical limit.** Bjorken, J.D.; Orbach, H.S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Annals of Physics (New York);* **141**: No. 1, 50-82(Jun 1982). Contract AC03-76SF00515.

A simple one-dimensional theory is considered in which a colored spinless quark and antiquark are bound together by a confining, color-dependent potential. To investigate the dynamics underlying Lipkin's mechanism of hidden charge, and how his conclusions are modified in the presence of symmetry breaking. The case of "frozen color" is considered. Using semiclassical WKB formalism, the spectrum of bound states is constructed. To determine the charge of the constituents, deep-inelastic scattering of an external probe (e.g., lepton) from our one-dimensional meson is considered. The structure function, Ω, is calculated explicitly in the WKB limit and it is shown how Lipkin's mechanism is manifested, as well as how scaling behavior comes about. The dominant physical process is one of excitation of a semiclassical state by the hard collision of the probe with the quark or antiquark. These considerations are generalized to the case of broken color symmetry—but where the breaking is not so strong as to allow low-lying states to have a large amount of mixing with the colored states. In this case, the degeneracy of excited colored states can be broken. Again deep-inelastic scattering can be used to measure the charges of the constituents, and there will again be a distinct contribution from each type of "classical" state which can be excited by the external probe. However, in the general case, the charge measured via excitation of a given state can be energy dependent. Local excitation of color is found to guarantee global excitation of color. However, global existence of color does not guarantee the excitation of colored states via deep-inelastic processes. Finally, even in the absence of direct physical application, we have examined how to implement the WKB method for bound-state problems in the presence of internal degrees of freedom.

62289 **A Monte Carlo study of the measurement of the energy of muons and of cascades in a DUMAND optical array.** Roberts, A. (Fermi National Accelerator Laboratory, Batavia, Ill.). pp 275-282 of DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 1 - array studies. Roberts, A. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

A Monte Carlo study program to determine the precision with which muon energy can be determined in a DUMAND array, as well as the effect of such precision on the disposition and spacing of sensors, is described. Adopting the formula of Adair and Kasha (1977), the muon's trajectory is divided into 100 m segments, and random selection of energy losses, with proper weighting, is applied. By thus treating a large number of muons of different energies, the mean energy losses in 100 m segments and their variances can be found and the total energy loss for each 100 m segment is calculated, one segment at a time. The unperturbed (by large fluctuations) energy loss and thus the particle energy is determined by measuring the energy loss dE/dx in several segments, while discarding the segments of largest energy loss. It is found that a 50% precision requirement for muon energy determination necessitates 400-600 m-long tracks, thus the unconventional hexagonal arrangement of the DUMAND array.

62290 **Monte Carlo simulation of inelastic neutrino scattering in DUMAND.** Roberts, A. (Fermi National Accelerator Laboratory, Batavia, Ill.). pp 55-70 of DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 2 - UHE interactions, neutrino astronomy. Roberts, A. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

Detailed Monte Carlo calculations simulating the detection in the DUMAND 1-cu-km optical detector of inelastic neutrino scattering by nucleons at 2 TeV and above show that the measurement of the y distribution is subject to systematic errors due to (1)

experimental errors and intrinsic fluctuations which produce errors in the energy determinations of hadronic cascade and muon and (2) uncertainty in the exact amount of antineutrino fraction in the cosmic-ray neutrino flux. The nature of these errors is explored, and methods for removing them from the data are developed. The remaining uncertainties are those in the evaluation of the errors in energy determination, and in the antineutrino contamination. It appears that these errors, not statistical ones, will eventually govern the accuracy of the y distributions obtained. Nonetheless the effect of the boson propagator on the y distribution is so marked that one can find no plausible scenario in which the residual errors cast doubt on whether or not the propagator effect is present.

62291 **(OUP—81-21) Diquark fragmentation functions in hadron-nucleon interactions at 19 GeV/c and other energies. The Scandinavian Bubble thamber collaboration.** Bakken, V.; Breivik, F.O.; Jacobsen, T. (Oslo Univ. (Norway). Fysisk Inst.). [nd]. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702616.

New data on pion production in pn-interactions at 19 GeV/c are used, together with earlier data on pion production in pn (π^+ n) at other energies, to determine the diquark fragmentation functions Dsup(π)$^{+-}$ sub(dd)(=Dsup(π)$^{+-}$ sub(uu)) and Dsup(π)sub(ud) in the neutron and proton fragmentation regions. Typical high energy data on pion production in pp-interactions are also considered. The unfavoured fragmentation function Dsup(π)$^{+}$ sub(dd)(x) is found to be much smaller than the favoured fragmentati ion function Dsup(π)$^{-}$ sub(dd)(x) and to have a steeper x-dependence. The diquark fragmentation functions agree very well with those from v(v^{-})- proton interactions as expected from quark parton models.

6453 Particle Invariance Principles And Symmetries

62292 **(IFVE-ONF/FTO/PK—80-145) CP violation and mixing mechanisms in neutral K and D meson systems.** Monich, V.A.; Volkov, G.G.; Struminsky, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1980. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82701638.

A contribution of weak interactions provided by Higgs boson exchange to CP violation and mixing in the K^0, anti K^0, D^0, anti D^0, ... systems in the framework of a standard scheme containing a few Higgs multiplets is obtained. It is assumed that CP invariance is spontaneously violated, CP parity conserves in strong interactions and the generalized diagonality principle takes place for the total Lagrangian of weak interactions. The searches for D^0 reversible anti D^0 mixing can help to understand the role of Higgs bosons in weak interactions.

62293 **Supersymmetry and the storage CP problem.** Nilles, H.P.; Raby, S. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Physics [Section] B;* **198**: No. 1, 102-112(26 Apr 1982).

We show how supersymmetric grand unified theories provide a natural solution to the strong CP problem. Such theories contain an additional global U(1)sub(PQ) chiral (Peccei-Quinn) symmetry which is conserved up to color anomalies. Hence the QCD THETA angle is irrelevant. Moreover the PQ symmetry is spontaneously broken at the grand unified scale. As a result the standard Weinberg-Wilczek axion has a mass msub(a) approx. equal to Asup(2QCD)/Asub(GUM) approx. equal to 10^{-10} eV which effectively decouples from ordinary matter.

6454 Field Theory

REFER ALSO TO CITATION(S) 62273

62294 **(HU-TFT—81-28) Renormalization group study of a critical lattice model I. Convergence to the line of fixed points.** Gawedzki, K.; Kupiainen, A. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 10 Jun 1981. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82702685.

We start a nonperturbative study of the Wilson-Kadanoff renormalization group (RG) in weakly coupled massless lattice models. Nonlocal hierarchical models are introduced to mimic the infrared behaviour of the (nabla phi)^2/2 + lambda(nabla phi)^4 model and the like. The RG is shown to drive these to the line of fixed points corresponding to the massless csub(infinity)(lambda)(nabla phi)^2/2 models.

62295 **(HU-TFT—81-30) Renormalization group study of a critical lattice model II. The correlation functions.** Gawedzki, K.; Kupiainen, A. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 27 Jul 1981. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702686.

Renormalization Group is used to study the correlation functions of a nonlocal hierarchical model mimicking the lambda(nabla phi)^4 model, dipole gas and the like. It is shown that the infrared behaviour of the correlations is that of the massless gaussian 1/2 c(lambda)(nabla phi)^2.

62296 **(JINR—R-2-81-655) Nonabelian models with dynamical symmetry breaking.** Chizhov, M.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702602.

Dynamical symmetry breaking in U(2)-symmetrical model with four-fermion interaction is considered. The stability group of the vacuum expectation of the Higgs field is O(2) group. The collective phenomena and the physical particle spectrum are found. In this model the coupling constants turn out to be the known functions of two parameters: of the Yukawa coupling constant and of the vacuum expectation value of the Higgs field.

62297 **(JINR—R-2-81-701) General integrals and the structure of general solution of the Chew-Low equations.** Rerikh, K.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702603.

The obtained before functional equations for the structural functions which determine the structure of two general integrals of Chew-Low equations are solved. The general integrals are found in approximation which makes it possible by inverting them to obtain the general solution of the Chew-Low equations in the form of the ratio of two series in the known antiperiodic function C(w) up to cubic terms in C(w). It is shown that in the defined n-approximation with respect to C(w) the correct behaviour in the Born pole already at n=1, can be obtained.

62298 **(LBL—14647) GUTs, SUSY GUTs and SUPER GUTs.** Gaillard, M.K. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 15p. (CONF-8205116—3). NTIS, PC A02/MF A01. Order Number DE82020100.

From 5. international conference on novel results in particle physics; Nashville, TN, USA (24 May 1982).

We review the motivations for extending grand unified theories with particular emphasis on supersymmetry and its phenomenological and cosmological fallout, and comment on the relevance of quantum gravity. 67 references.

62299 **(NBI-HE—82-8) Mean field methods in lattice gauge theories.** Lautrup, B. (Niels Bohr Inst., Copenhagen (Denmark)). Mar 1982. 20p. (CONF-820390—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702690.

From 13. spring symposium on high energy physics; Bad Schandau, F.R. Germany (23 Mar 1982).

Mean field theory for lattice gauge theory is formulated as a saddle point expansion. One-loop corrections are evaluated for Z(2), SO(3) and mixed SU(2)-SO(3). Excellent agreement with Monte Carlo data is obtained.

62300 **Stochastic quantization of gauge theories*.** McClain, B.; Niemi, A.; Taylor, C. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Annals of Physics (New York);* **140**: No. 2, 232-246(May 1982).

The equivalence between a scalar quantum field theory in D dimensions and its classical counterpart in D+2 dimensions which is coupled to an external random source with Gaussian correlations was observed by previous authors. This stochastic quantization is extended to gauge theories. The proof exploits the supersymmetry formalism suggested by Parisi and Sourlas.

62301 **Topologically massive gauge theories.** Deser, S.; Jackiw, R.; Templeton, S. (Department of Physics, Brandis University, Waltham, Massachusetts 02254). *Annals of Physics (New York);* **140**: No. 2, 372-411(May 1982). Contract AC02-76ER03069.

Gauge vector and gravity models are studied in three-dimensional space-time, where novel, gauge invariant, P and T odd terms of topological origin give rise to masses for the gauge fields. In the vector case, the massless Maxwell excitation, which is spinless, becomes massive with spin 1. When interacting with fermions, the quantum theory is infrared and ultraviolet finite in perturbation theory. For non-Abelian models, topological considerations lead to a quantization condition on the dimensionless coupling constant-mass ratio. Ordinary Einstein gravity is trivial, but when augmented by our mass term, it acquires a propagating, massive, spin 2 mode. This theory is ghost-free and causal, although of third-derivative order. Quantum calculations are presented in both the Abelian and non-Abelian vector models, to exhibit some of the delicate aspects of infrared behavior, and regularization dependence.

62302 **Fast algorithm for Monte Carlo simulations of 4-d lattice gauge theories with finite groups.** Bhanot, G. (Institute for Advanced Study, Princeton, NJ (USA)); Lang, C.B. (European Organization for Nuclear Research, Geneva (Switzerland)); Rebbi, C. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.). *Computer Physics Communications;* **25**: No. 3, 275-287(Mar 1982).

The program LATGAUGEMC generates configurations of the link-gauge variables of a 4-dimensional hypercubic lattice of linear extent 2, 4 or 8 with periodic boundary conditions. The link variables take values from any group where the number of group elements plus the number of elements equal to their own inverse is less than 128. The Monte Carlo method used to update the link variables is the Metropolis method. The configurations generated by the program are representative of the ensemble of configurations on a finite lattice that defines the partition function of a lattice gauge field theory. They may be used to evaluate expectation values of functions of the gauge variables. The program has been used by the authors to study the 4-dimensional SU(2) lattice gauge theory. It could be used for Monte Carlo simulations of other problems in statistical mechanics and particle physics.

6455 Scattering Theory

62303 **(PM—81/7) Theoretical considerations for inverse scattering.** Sabatier, P.C. (Montpellier-2 Univ., 34 (France). Dept. de Physique Mathematique). 1981. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82903592.

Inversion Theory is a guide for handling inverse problems rather than a set of inversion techniques. The usual ill-posedness of inverse problems has first to be dealt with by reassessing the concept of solution and by giving a detailed answer to the basic mathematical questions of solutions existence, uniqueness, construction, stability, approximation. But this is not sufficient. If the results are to be used by physicists, they should take into account the fact that no physical problem can be given a complete study separately from all others. In other words, investigating mathematical questions, and in particular describing the sets of solutions, must be done in such a way that physical motivations and physical considerations are always apparent. These remarks are illustrated on several examples taken in Scattering Theory.

65 PHYSICS RESEARCH

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 61428, 61429, 61430, 61432, 61433, 61434, 61437, 61439, 61440, 62463

62304 **(CONF-811253—Pt.1) Silver Jubilee physics symposium. Volume 24B.** (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). 1981. 297p. Dep. NTIS (US Sales Only), MF A01. Order Number DE82905330.

From Silver jubilee physics symposium; Bombay, India (28 Dec 1981).

Portions of document are illegible.

This section of the proceedings of this twenty-fifth Nuclear Physics and Solid State Physics Symposium covers light ion induced reactions, heavy ion induced reactions, intermediate energy nuclear physics, nuclear fission, nuclear forces and nuclear matter, nuclear spectroscopy, nuclear structure theory, and nuclear instruments and experimental techniques. (GHT)

62305 **(DOE/ER/10364—33) Progress report and research proposal.** (Minnesota Univ., Minneapolis (USA). Dept. of Physics and Astronomy). 1982. Contract AC02-79ER10364. 35p. NTIS, PC A03/MF A01. Order Number DE82021048.

Research carried out includes: interpretation of mean-free-paths of projectile fragments from relativistic heavy-ion collisions; inelastic excitation and spin-flip in heavy ion reactions; inelastic scattering and the optical potential for $^{16}O + {}^{28}Si$; elastic scattering of protons by ^{6}Li; scattering of light ions by ^{6}Li; specific distortion effects in $^{3}H + \alpha$ and $^{3}He + \alpha$ systems; specific distortion effects in the $d + \alpha$ system and charge form factor of ^{6}Li; detailed investigation of exchange effects in $^{3}He + \alpha$ and $\alpha + {}^{16}O$ scattering; study of the $n + {}^{6}Li$ system with flexible cluster wave function; core-exchange effects in like-ion scattering; reaction cross-section for collision of nuclei at high energy; study of $^{46,48}Ca(\alpha,p)$ reactions; the proximity potential for heavy-ion reactions on deformed nuclei; quasi-bound state resonances for a particle in a two-dimensional well; time evolution kernels, uniform asymptotic expansions; and a generator coordinate theory of normalization kernels of cluster systems, application of Gel'fand polynomials to permutation and SU_4 symmetries of cluster wave functions. (GHT)

62306 **Recent references January through April 1982.** Ramavataram, S. (Brookhaven National Laboratory, Upton, New York 11973, USA). *Nuclear Data Sheets;* **35**: No. 1, 1-100(Jan 1982). Contract AC02-76CH00016.

Key numbers, keywords, a reaction index, and references are given for all literature received or classified by the National Nuclear Data Center between January and April 1982. (AIP)

6511 Experimental Techniques

62307 **(INFN/FM—80/1) Ionic implant for use in nuclear targets.** Foti, G.; Ciavola, G.; Trovato, A. (Istituto Nazionale di Fisica Nucleare, Catania (Italy)). 23 Jul 1980. 10p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82903240.

An experimental determination is made of the accumulated dose of ion implants in relation to the ion-target combination. An analysis is made of the properties of the implanted target after prolonged exposure to particle beams. Graphic data are presented on backscattering spectra of 2.0 MeV He^+ by carbon films implanted with 50 keV of Ar^+, the effect of sputtering in implanted targets at high doses, and a $^{14}N(d,a)$ nuclear reaction for measuring the dose of nitrogen implanted on tantalum. Electronmicroscopic photos are also presented of aluminum implants. The experimental results indicate that doses of about 10^{17} atoms/cm^2 can be easily obtained. Ion implantation is found to be a very reliable and reproducible system and very suitable for nuclear research studies. 11 figures.

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 62279

62308 **(WIS-Ph—81/57) Polarization of recoil deuteron in ed elastic scattering at medium energies.** Bhalerao, R.S. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Dec 1981. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702531.

Vector and tensor polarizations of the recoil deuteron in ed elastic scattering are calculated for THETA=0deg-180deg and $q^2 <= 8(GeV/c)^2$. A longitudinally polarized electron beam is assumed to scatter off an unpolarized deuteron target. Calculations are made in the relativistic impulse approximation using a recently described approach based on the Bethe-Salpeter equation. Results are different, at high q^2 even qualitatively so, from those of a non-relativistic calculation, and a relativistic calculation which takes the spectator nucleon on-mass-shell. In the light of these results a recent suggestion that the polarization measurements would throw new light on the off-shell behavior and tensor force strength of the NN interaction are reexamined. Results are also presented for the three deuteron form factors Gsub(C), Gsub(Q), and Gsub(M), and the often-needed related quantities Ssub(S), Ssub(Q), and Ssub(M). The latter results may have an important implication in high-momentum transfer reactions involving deuteron.

6513 Nuclear Properties And Reactions, A=6-19

62309 **(INIS-mf—7195) Nucleon scattering on one-hole nuclei in the framework of the continuum RPA. Calculations for the reactions $^{15}N(p,n)^{15}O$ and $^{15}N(n,n')^{15}N$.** Abdi, S.M. (Muenchen Univ. (Germany, F.R.). Fachbereich Physik). 28 Mar 1979. 106p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE82780738.

Thesis.

It is shown that the scattering transition amplitude for nucleon-nucleus scattering on one-hole nuclei can be directly related to so-called linear response function. The theory of the linear response function is formulated in the framework of Greens functions. The linear response function obreys an equation of Bethe-Salpeter-type. From to the spectral decomposition of the response function one can deduce, that the knowledge of the response function in equivalent to the knowledge of the so-called 'particle-hole'- and 'hole-particle'-amplitudes, respectively, and the exitation energies of the compound A-particle system. In this work the binding- and resonance energies for ^{16}O and ^{16}N, respectively, have been calculated, which are needed for the scattering processes $^{15}N(p,n)^{15}O$ and $^{15}N(n,n')^{15}N$, respectively. For low energies the agreement with experiment is not statisfactory, probably due to the coupling to 3p-3h-states, which was neglected in the treatment. (orig./HSI).

62310 **(ITF—82-54E) Study of 0^+ state structures of ^8Be using the basis of cluster hyperspherical harmonics.** Vasilevskii, V.S.; Nesterov, A.V.; Filippov, G.F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). May 1982. 32p. Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR.

A simple algorithm of going beyond the minimal approximation of K-harmonic method at the expense of the basis functions actual in view of a cluster model is proposed and realized by an example of the calculation of 0^+ states of ^8Be. The harmonics with K/sub min/ $\leqq$ K $\leqq$ K/sub min/ + 26 are used. The numerical results are discussed and compared with experimental data.

62311 **Angular distributions of single pion charge exchange reactions to isobaric analog states in light nuclei.** Doron, A.; Alster, J.; Erell, A.; Moinester, M.A.; Anderson, R.A.; Baer, H.W.; Bowman, J.D.; Cooper, M.D.; Cverna, F.H.; Hoffman, C.M.; King, N.S.P.; Leitch, M.J.; Piffaretti, J.P.; Goodman, C.D. (Department of Physics and Astronomy, Tel Aviv University, Ramat Aviv, Israel). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 189-197(Jul 1982).

Measurements of the angular distributions of the single charge exchange reactions to isobaric analog states for $^{13}C(\pi^+,\pi^0)^{13}N$ and $^{15}N(\pi^+,\pi^0)^{15}O$ at 165 MeV are described. The two angular distributions are very similar. The shapes are reproduced by semiphenomenological isobar-doorway calculations and by second-order coupled channels calculations. The calculated magnitudes are low by about a factor of 2. Phenomenological calculations that agree with small-angle excitation functions do not reproduce the angular distributions. The measurements are consistent with older angle-integrated cross sections for ^{13}C.

62312 **Half-life of ^6He.** Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 252-253(Jul 1982).

A remeasurement of the half-life of ^6He has been carried out by forming the activity in the $^9Be(n,\alpha)^6He$ reaction, transferring samples to a plastic detector, and multiscaling β-ray counts. Activities were produced in either Be metal or pure Be crystal. No significant differences were noted in results depending on the type of sample, β-ray bias, initial counting rate, or starting channel in the analysis. The adopted value, T/sub 1/2/ = 805.4 +- 2.0 ms, is in agreement with a previous Brookhaven result but disagrees with recent work by Barker et al.

62313 **Dominance of nucleon-nucleon interactions in $\alpha + ^{12}C$ total reaction cross sections.** DeVries, R.M.; DiGiacomo, N.J.; Kapustinsky, J.S.; Peng, J.C.; Sondheim, W.E.; Sunier, J.W.; Cramer, J.G.; Loveman, R.E.; Gruhn, C.R.; Wieman, H.H. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 301-303(Jul 1982).

We have measured $\alpha + ^{12}C$ total reaction cross sections (σ/sub R/) at E/sub lab/ = 94 and 173 MeV/N using the attenuation method. Our data indicate a decreasing σ/sub R/(E) at intermediate incident energies. These results, along with existing measurements, are in quantitative agreement with theoretical predictions for σ/sub R/(E) which are based on nucleon-nucleon total cross sections.

6517 Nuclear Properties And Reactions, A=90-149

62314 **(JINR—E-4-81-637) Calculated spectrum of streched γ-rays from the high-spin states in ^{118}Te.** Cwiok, S.; Mikhajlov, I.N.; Nazmitdinov, R.G.; Nazarewicz, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702529.

In the framework of the cranking model and the method of Strutinsky the γ-ray intensity of ^{118}Te from the high spin region is calculated. The average nuclear field is approximated by the Woods-Saxon potential. It is supposed that the main part of the γ-ray intensity is formed by the quadrupole γ-rays. The results of calculations are in agreement with the experimental data.

62315 **(JYFL-RR—18/81) What can we learn from E0 transitions - and how.** Kantele, J. (Jyvaeskylae Univ. (Finland). Dept. of Physics). 1981. 91p. NTIS (US Sales Only), PC A05/MF A01.

Portions of document are illegible.

A review is given on the physics one can learn from E0 transitions between 0^+ states of even-even nuclei. Recent developments of new experimental techniques for the measurements of conversion-electron and internal-pair-formation spectra, Coulomb excitation, and nuclear lifetimes are also discussed, as well as new experimental data. The present status of the field and some future expectations are also considered.

62316 **(ORNL/TM—8285) Electron spectra from decay of fission products.** Dickens, J.K. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 97p. NTIS, PC A05/MF A01. Order Number DE82021114.

Electron spectra following decay of individual fission products (72 $\leqq$ A $\leqq$ 162) are obtained from the nuclear data given in the compilation using a listed and documented computer subrou-

tine. Data are given for more than 500 radionuclides created during or after fission. The data include transition energies, absolute intensities, and shape parameters when known. An average beta-ray energy is given for fission products lacking experimental information on transition energies and intensities. For fission products having partial or incomplete decay information, the available data are utilized to provide best estimates of otherwise unknown decay schemes. This compilation is completely referenced and includes data available in the reviewed literature up to January 1982.

62317 **(UCID—19549) User's manual for the code STAPRE as implemented at Lawrence Livermore National Laboratory.** Vonach, H. (Lawrence Livermore National Lab., CA (USA)). 17 Aug 1982. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01. Order Number DE82022034.

This report gives a detailed description of the input and output of the statistical model code STAPRE for compound-nucleus reactions including a special section on the various level density options of the code. It is to be used in conjunction with the report IRK 76/01 + Add 76 + Add 78 by B. Strohmaier and M. Uhl which describes in detail the physical models on which the code is based and its general organization and structure.

62318 **Excitation functions of the $^{127}I(\pi^{+-},\pi N)^{126}I$ reactions in the vicinity of the (3,3) resonance.** Ohkubo, Y.; Porile, N.T.; Orth, C.J. (Department of Chemistry, Purdue University, West Lafayette, Indiana 47907). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 198-203(Jul 1982).

Excitations functions for the formation of ^{126}I from ^{127}I have been determined with 60—350 MeV $\pi$and π^-. The contributions of both direct nucleon knockout and pion inelastic scattering followed by neutron evaporation are visible in the excitation functions. The results are compared with an cascade-evaporation calculation, the Sternheim-Silbar nucleon charge exchange models, and the semiclassical model of Ohkubo and Porile.

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 62315

62319 **(CONF-820942—6) Neutron capture cross sections of $^{178,179,180}Hf$ and the origin of nature's rarest stable isotope ^{180}Ta.** Beer, H.; Macklin, R.L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Kernphysik 1; Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE82022340.

From Nuclear data for science and technology international conference; Antwerp, Belgium (6 Sep 1982).

The neutron capture cross sections of $^{178,179,180}Hf$ were measured in the energy range 2.6 keV to 2 MeV. The average capture cross sections were derived and fitted in terms of strength functions. Resonance parameters for the observed resonances below 10 keV were determined by shape analysis. Maxwellian-averaged capture cross sections were computed for thermal energies with kT between 5 and 100 keV. The cross sections for kT = 30 keV were used to determine the population probability of the 8- isomeric level in ^{180}Hf by neutron capture as (1.24 +- 0.06)% and the r-process abundance of ^{180}Hf as 0.0290 (Si = 10^6). These quantities served to analyze s- and r-process nucleosynthesis of ^{180}Ta, nature's rarest stable isotope.

62320 **(INIS-mf—7147) Study of the rotational states in the framework of the Hartree-Fock-Bogoljubov theory.** Samadi, B. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet Physik). 30 Jul 1980. 124p. (In German). NTIS (US Sales Only), PC AXX/MF A01. Order Number DE82780736.

Thesis.

Using the solutions of the HFB equation the author has calculated the rotational states of ^{168}Yb and ^{164}Er with the aid of a projection-variational method. (HSI).

62321 **(JINR—6-81-388) Properties of low-lying states in Ho odd-odd nuclei with A=156, 158 and 160 populated in beta decay of Er isotopes.** Vylov, Ts.; Kalinnikov, V.G.; Kuznetsov, V.V.; Li Zon Sik; Solnyshkin, A.A.; Yushkevich, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1981. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702533.

Radioactive decays of neutron-deficient isotopes ^{156}Er (Tsub(1/2)=19.5 min), ^{158}Er (Tsub(1/2)=2.24 h) and ^{160}Er (Tsub(1/2)=30 h) have been investigated. Gamma-radiation has been measured by means of spectrometers with Ge (Li) detectors. Internal conversion electron spectra have been measured by means of iron-free beta-spectrometer with toroidal magnetic field and beta-spectrograph with constant homogeneous magnetic field. To confirm schemes of the studied isotope decay the measurements of e-γ-coincidences have been performed at the installation created on the base of a beta- spectrometer with toroidal magnetic field and gamma-spectrometer with Ge(Li) detector. Mass differences $\Delta M(^{156}Er \rightarrow ^{156}Ho) = 1670\text{-}L_{-85}{}^{+105}$ keV, $\Delta M(^{158}Er \rightarrow ^{158}Ho) = 1706\text{-}L_{-35}{}^{+55}$ keV and $\Delta M(^{160}Er \rightarrow ^{160}Ho) = 370\text{-}L_{-90}{}^{+100}$ keV have been defined. First forbidden beta-transitions of the type $0^+ \rightarrow 1^-$ have been confidently identified in the decay of ^{156}Er and ^{158}Er with anomalously small values lgft=5.2 and 5.4, respectively. One does not observe in the ^{158}Ho nucleus the population from the ^{158}Er decay of the level 1^+, [p523 excitation n523 de-excitation] expected in accordance with theories. Reliable arguments have been obtained in favour of excitation of the state ^{160}Ho with $I=1^+$ of the above indicated type from ^{160}Er decay. Using as an example the beta-decay $^{156}Er \rightarrow ^{156}Ho$ there has been demonstrated experimentally there are no delayed beta-transitions which have been expected to occur due to sharp differencies in the nuclei shapes.

62322 **(JINR—R-4-81-238) Emission of high particles in heavy ion reactions.** Dzholos, R.V.; Ivanova, S.P.; Kartavenko, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702530.

The mechanism of emission of light particles in heavy ion reactions at approximately 10 MeV/nucleon is investigated. The contribution of evaporation mechanism has been calculated. A model for the description of high energy part of emission spectrum is proposed. The results of theoretical calculations are compared with the experimental data on emission of neutrons and alpha- particles. The results of the calculation of energy neutron spectrum in $^{181}Ta + ^{22}Ne$ and $^{158}Gd + ^{12}C$ reactions as well as energy spectrum of alpha particles in the $^{181}Ta + ^{22}Ne$ reaction are presented. The cross section of the heavy ion reaction of above energies consists of preequilibrium as well as evaporation components. In the $^{158}Gd + ^{12}C$ reaction the transition from the evaporation component to the preequilibrium one manifests more clearly than in the $^{181}Ta + ^{22}Ne$ reaction.

62323 **(JINR—R-6-81-454) $^{163}Tm \rightarrow ^{163}Er$ radioactive decay. 1. Experimental results.** Vylov, Ts.; Gorozhankin, V.M.; Gromov, K.Ya.; Kuznetsov, V.V.; Kretsu, T.; Lebedev, N.A.; Yushkevich, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1981. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702535.

Spectra of positrons, KX- and γ-rays, internal conversion electrons and e-γ-coincidence are investigated at the $^{163}Tm \rightarrow ^{163}Er$ decay. The measurements of discrete radiation spectra are performed using spectrometers with Ge(Li) and Si(Li) detectors. Investigations of positron radiation are carried out by means of iron-free beta-spectrometer with toroidal magnetic field. Half-life Tsub(1/2)=1.810+-0.005 h, decay energy $\sup(Q)\beta$=2439+-3 keV of ^{163}Tm, as well as the energies and probabilities of transitions observed in the decay of ^{163}Tm have been measured with more precision. 254 gamma-transitions have been found for which energy values as well as those intensities of γ-beams and internal conversion electrons have been measured with more precision. 46 transitions from them are observed for the first time. For 174 γ-transitions the conclusions are drawn regarding their multipolarity. More

detailed data on temporal transition coincidences and positrons at the ^{163}Tm decay are obtained. The totality of above data allows to propose the most complete scheme of the ^{163}Tm decay.

62324 **(LA-UR—82-2456) Analysis of n+165Ho and ^{169}Tm reactions.** Young, P.G.; Arthur, E.D.; Philis, C.; Nagel, P.; Collin, M. (Los Alamos National Lab., NM (USA); CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). 1982. Contract W-7405-ENG-36. 5p. (CONF-820942—4). NTIS, PC A02/MF A01. Order Number DE82021894.

From Nuclear data for science and technology international conference; Antwerp, Belgium (6 Sep 1982).

Experimental data for neutron-induced reactions on ^{165}Ho and ^{169}Tm have been theoretically analyzed in preparation for calculations on the unstable isotopes of Tm. A set of deformed optical model parameters was determined from measurements of s- and p-wave neutron strength functions, total cross sections, elastic angular distributions, and 16-MeV proton scattering to the ^{165}Ho ground and first excited states. The parameters for the ^{165}Ho and ^{169}Tm nuclei were linked by means of an isospin term in the real and imaginary well depths, together with adjustment of the β_2 and β_4 deformation parameters based on systematics in this mass region. Transmission coefficients from this analysis were used in Hauser-Feshbach statistical model calculations of the ^{169}Tm(n,γ) cross section as well as the ^{169}Tm(n,2n) and (n,3n) cross sections to 23 MeV, after application of suitable preequilibrium corrections. The results of these calculations are in good agreement with most of the available experimental data on ^{165}Ho and ^{169}Tm.

62325 **Reduced transition probabilities of vibrational states in /sup 156,158/Dy, /sup 162,164/Er, and ^{168}Yb.** Ronningen, R.M.; Grantham, R.S.; Hamilton, J.H.; Piercey, R.B.; Ramayya, A.V.; van Nooijen, B.; Kawakami, H.; Lourens, W.; Lee, R.S.; Dagenhart, W.K.; Riedinger, L.L. (Department of Physics, Vanderbilt University, Nashville, Tennessee 37235). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 97-106(Jul 1982).

The vibrational states of /sup 156,158/Dy, /sup 162,164/Er, and ^{168}Yb have been studied via Coulomb excitation. Thin high purity targets were prepared in an isotope separator. The Coulomb excitation of these nuclei was studied by the scattering of 12—16 MeV α particles, which were detected in an Enge splitpole spectrograph. The reduced transition probabilities B(Eλ;0/sub g.s./$^+\rightarrow$I/sup π/K) were obtained for I/sup π/K = 2^+2, 2^+0, and I/sup π/ = 3^- states in each nucleus. Limits on B(Eλ) values and values extracted from published (d,d') cross sections are also presented. Trends in B(E2) values and energy levels for the Dy, Er, and Yb nuclei show that the K/sup π/ = 2^+ levels are reasonably constant in energy for only Dy and Er. In all three nuclei B(E2) values decrease with increasing neutron number. Except for the Dy isotopes, the lightest isotope has the largest B(E2) value for the lowest lying I/sup π/K = 2^+0 state. I/sup π/ = 3^- states level energies and B(E3) values are found to be in fair agreement with microscopic calculations. Values of B(E2) for K/sup π/ = 2^+ states are in fair agreement with microscopic calculations when these exist.

62326 **Interacting negative-parity bands in ^{164}Er.** Fields, C.A.; Hicks, K.H.; Ristinen, R.A.; de Boer, F.W.N.; Peker, L.K.; Walker, P.M. (Nuclear Physics Laboratory, Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 290-293(Jul 1982).

The interactions between a K/sup π/ = 5^- aligned two-quasineutron band and two octupole bands have been observed in ^{164}Er. Band crossings occur in both even- and odd-spin sequences. The members of all three bands are observed from the bandheads (L/sup π/ = 1^-, 2^-, and 5^-) to about 12^-.

6519 Nuclear Properties And Reactions, A=190-219

62327 **(DOE/ER/03346—250) Nuclear-chemistry research and spectroscopy with radioactive sources. Eighteenth annual progress report.** Fink, R.W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). 31 Jul 1982. Contract AS05-76ER03346. 37p. (ORO—3346-250). NTIS, PC A03/MF A01. Order Number DE82021939.

Portions of document are illegible.

Progress is reported on nuclear spectroscopy studies including lifetimes of the g/sub 7/2/ shell-model intruder states in ^{107} ^{109}Ag, lifetime of the new /sup 187m/Au isomer, the decay of ^{187}Au - ^{187}Pt, decay of /sup 201m,g/Po, ^{203}At, and ^{135}Ba, and L-shell orbital EC probability and decay energy in ^{207}Bi decay. Also progress on nuclear model calculations of nuclear structure is reported. (WHK)

62328 **Reply to "Comment on 'Exactly central heavy-ion collisions by nuclear hydrodynamics' ".** Tang, H.H.K.; Wong, C. (Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 284-286(Jul 1982). Contract W-7405-ENG-26.

We reply to a recent comment concerning our work on nuclear hydrodynamics. A previous numerical error is corrected, and a sample of corrected results is presented.

6520 Nuclear Properties And Reactions, A=220 And Above

62329 **(BLG—539) Energy distributions and emission probabilities of light particles emitted during tripartition.** Wagemans, C.; d'Hondt, P.; de Clercq, A.; Allaert, E.; Barreau, G.; Deruytter, A. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Oct 1980. 23p. (In French). (CONF-8010218—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82902859.

From Meeting on fission; L'Alpe d'Huez, France (6 Oct 1980).

The energy distributions and the yields of the main charged light particles emitted during the thermal neutron induced ternary fission of ^{233}U were studies using a very pure neutron beam of the Grenoble high flux reactor. Also the energy distributions and the absolute yields of the ternary α-particles emitted during the thermal neutron induced fission of ^{233}U, ^{237}Np and ^{239}Pu have been determined. The energy distributions of the α-particles deviate from a gaussian distribution, which is not the case for all the other particles considered. Explanations for this phenomenon are presented. Finally, the present status of our knowledge of some ternary fission characteristics is reviewed.

62330 **Linear momentum transfer in nonrelativistic nucleus-nucleus collisions.** Viola, V.E. Jr.; Back, B.B.; Wolf, K.L.; Awes, T.C.; Gelbke, C.K.; Breuer, H. (Department of Chemistry and Cyclotron Facility, Indiana University, Bloomington, Indiana 47405). *Physical Review [Section] C: Nuclear Physics;* **26**: No. 1, 178-188(Jul 1982).

The systematic behavior of linear momentum transfer from projectile to target in nonrelativistic nucleus-nucleus collisions has been studied using the results of fission-fragment angular-correlation measurements on uranium target nuclei. Data for ^{4}He, ^{12}C, ^{16}O, and ^{20}Ne projectiles have been analyzed over an energy range which extends well above the interaction barrier. The data illustrate the division of the total reaction cross section into two primary components: one associated with $\sim$ 90 percent or greater linear momentum transfer and the other involving much smaller amounts of linear momentum transfer. The former is attributed to fusionlike collisions and the latter to peripheral collisions. The minimum between these two components corresponds to a linear momentum transfer of about 50 percent. It is observed that the ratio of fusion-like collisions to the total reaction cross section decreases regularly as a function of both increasing bombarding energy and projectile mass. From comparison of the experimental fission-fragment angular correlation functions with the predictions of complete fusion kinematics, it is shown that above 10 MeV/ nucleon, the experimental definition of complete fusion is complicated by the increasing probability for large, but incomplete, linear momentum transfer

collisions. Estimates of critical angular momenta derived from these data do not show any major disagreement with rotating-liquid-drop predictions.

62331 **A phenomenological model for particle production from the collision of nucleons at medium energies with fissile elements.** Alsmiller, F.S.; Alsmiller, R.G.; Barish, J.; Gabriel, T.A.; Lillie, R.A. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **35**: 475-477(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

62332 **Thermal-neutron flux generation by high-energy protons in thick uranium targets.** Alsmiller, R.G.; Alsmiller, F.S.; Barish, J.; Gabriel, T.A. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **35**: 477-478(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 62241, 62317, 62328

62333 **(INIS-mf—7145) Pauli-correct separable potentials for interactions of composite particles.** Kircher, R. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 11 Feb 1981. 70p. (In German). NTIS (US Sales Only), PC AXX/MF A01. Order Number DE82780735.

Thesis.

A method is presented for the construction of separable potentials over the wave functions of the optical fishbone model or the resonating group method. The separable potentials reproduce not only the on-shell information, but also the off-shell information of the nonseparable interactions in a pretended energy range. The correct reproduction especially of the off-shell information is of particular importance because the off-shell behaviour of the interactions of composite particles is strongly influenced by the Pauli principle. The separable potentials constructed in such a way are real, symmetric, and energy-independent. An essential attribute of these unitary interpolation method consists of the fact that by the separable potential the optical fishbone model is reproduced, the on-shell behaviour of which is fitted by the experimental data. By this a potential is obtained, which can be called hybrid potential, because the on-shell behaviour follows from the experiment, the off-shell behaviour against it from the Pauli principle i.e. from the theory. As numerical examples separable potentials for the elastic α-α scattering and the elastic N-α scattering were constructed. Thereby not only the phase curves of the pretended model are quite well reproduced, but also the wave functions in the short range, where they are very sensitive to the influence of the Pauli principle. (orig.).

62334 **(INIS-mf—7149) Phase transitions in high density nuclear matter.** Hofmann, J. (Frankfurt Univ. (Germany, F.R.). Fachbereich Physik). 17 Aug 1979. 95p. (In German). NTIS (US Sales Only), PC AXX/MF A01. Order Number DE82780737.

Thesis.

A method for the description of spin-isospin phase transitions in nuclear matter is developed. It allows a complete description of the pion condensation phase transition in the framework of the Landau-Migdal Fermi liquid theory. The equation of the order parameters is derived and the condensation energy is calculated. We study the influence of pion condensation on the nuclear equation of state and the temperature dependence of pion condensation. Finally the phase transition from nucleon to quark matter is investigated. The relevance of the color degree of freedom is discussed. (orig.).

62335 **(ITF—82-96P) Elliott SU(3) model and rotational excitations of near-magic nuclei.** Okhrimenko, I.P.; Steshenko, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Jun 1982. 48p. (In Russian). Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR.

The Elliott nuclear model is applied to study the properties of the ground and rotational states of a large group of the even-even near-magic atomic nuclei from ^{4}He up to ^{44}Ti included. For each of the nuclei the specific energy formulas of the ground and excited states are obtained for the exchange central NN-forces with the Gaussian radial dependence. The different characteristics of rotational levels are considered.

62336 **Scattering with absorptive interaction.** Cassing, W.; Stingl, M.; Weiguny, A. (University of Muenster, Muenster, West Germany). *Physical Review* [*Section*] *C: Nuclear Physics;* **26**: No. 1, 22-33(Jul 1982).

The S matrix for a wide class of complex and nonlocal potentials is studied, with special attention to the motion of singularities in the complex k plane as a function of the imaginary coupling strength. Modifications of Levinson's theorem are obtained and discussed. Analytic approximations to the S matrix in the vicinity of narrow resonances are exhibited and compared to numerical results of resonating-group calculations. The problem of defining resonances in the case of complex interactions is discussed, making contact with the usual analysis of scattering in terms of Argand diagrams.

62337 **Form factors for inelastic excitation of vibrational bands in deformed nuclei.** Oberacker, V.E.; Roades-Brown, M.J.; Satchler, G.R. (Department of Physics and Astronomy, Vanderbilt University, Nashville, Tennessee 37235). *Physical Review* [*Section*] *C: Nuclear Physics;* **26**: No. 1, 129-137(Jul 1982).

Within the framework of the collective model, form factors are calculated for the inelastic excitation of quadrupole vibrational bands and the yrast band in deformed even-even nuclei. In the case of a "pure" vibrational band, analytical expressions are derived for a nuclear potential of exponential type. The general results include a numerical treatment of the vibration-rotation interaction; hence, the form factors should be useful in the intermediate spin region.

62338 **Quadrupole states and the interacting boson approximation.** Chasman, R.R. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **26**: No. 1, 225-227(Jul 1982). Contract W-31-109-ENG-38.

A schematic shell model calculation is used to analyze the adequacy of the interacting boson approximation as a function of the quadrupole interaction strength V. It is found that an interacting boson approximation basis truncation approximation provides a good description of the nuclear ground state, but a poor one of moderately high angular momentum states, for all values of V. An alternate basis truncation scheme is proposed.

62339 **Microscopic foundation of the interacting boson model.** Wu, C.; Feng, D.H.; Chen, J.; Guidry, M.W. (Department of Physics, Jilin University, Changchun, Jilin, The People's Republic of China). *Physical Review* [*Section*] *C: Nuclear Physics;* **26**: No. 1, 308-311(Jul 1982).

An effective boson Hamiltonian is derived from the original Hamiltonian of a many-fermion system. The results show that when the intrinsic motion of bosons is collective and the excitation energies of the system are small, the effective boson-boson interaction can be reduced to a two-body interaction while for odd systems or systems with uncorrelated fermions, there is an additional two-body boson-fermion interaction. Both these interactions can be calculated from the original fermion-fermion ones. Thus, the microscopic foundation of the interacting boson model is established without recourse to mapping procedures.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 61427, 61917

62340 **(AD-A—112303/3) Armored vehicle shielding against radiation.** Davidson, C.N. (Army Nuclear and Chemical Agency, Springfield, VA (USA)). May 1979. 16p. NTIS, PC A02/MF A01.

Nuclear weapons may be used at any time on the tactical battlefield. The ability to operate effectively in such an environ-

ment and to employ nuclear weapons with confidence requires a knowledge of the protection provided crew members by representative US and Soviet armor. An understanding of the operational advantages to be gained from shielding improvements is also important. This note will summarize the shielding which armored vehicles provide against residual nuclear radiation, initial nuclear radiation, and neutron induced radioactivity in the tank armor itself; and will highlight the payoffs associated with improving this shielding.

62341 **(BNL—31793) Incommensurate structures.** Axe, J.D. (Brookhaven National Lab., Upton, NY (USA)). Aug 1982. Contract AC02-76CH00016. 6p. (CONF-820950—1). NTIS, PC A02/MF A01. Order Number DE82021568.

From Conference on the neutron and its applications; Cambridge, UK (13 Sep 1982).

A review is given of neutron scattering studies of displacive incommensurate structures, and of the instabilities of crystalline solids that lead to their formation.

62342 **(CONF-820931—6) Physical and chemical evolution of an electron track in liquid water.** Wright, H.A.; Turner, J.E.; Hamm, R.N.; Ritchie, R.H.; Magee, J.L.; Chatterjee, A. (Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA)). 1982. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01. Order Number DE82022287.

From 8. symposium on microdosimetry; Julich, F.R. Germany (27 Sep 1982).

We present a model to determine the position and identity of each species about the track of an electron in liquid water at any time from the passage of the primary electron (which occurs in approx. 10^{-15} s) to times of the order of a microsecond at which chemical evolution of the track is essentially complete.

62343 **(CONF-820931—7) Comparison of electron-transport calculations for water in the liquid and vapor phases.** Turner, J.E.; Paretzke, H.G.; Hamm, R.N.; Wright, H.A.; Ritchie, R.H. (Oak Ridge National Lab., TN (USA); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). 1982. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE82022288.

From 8. symposium on microdosimetry; Julich, F.R. Germany (27 Sep 1982).

Information on electron track structure in liquid water is a prerequisite for understanding many radiation effects. Since most available data exist for the vapor and few exist for the liquid, it is essential to understand how differences in the state of condensation affect energy-loss phenomena. In this paper we compare results of two independent electron transport codes for water in the gaseous and liquid phases, respectively. Although several essential phase-dependent differences occur in the cross sections used as input data in the two codes, spatial energy deposition and total mass stopping power are found not to depend critically on the phase. The respective yields of ionizations and excitations produced during energy deposition can, however, differ markedly between the liquid and gaseous states. 26 references, 8 figures.

62344 **(CONF-820942—7) Neutron filters for producing monoenergetic neutron beams.** Harvey, J.A.; Hill, N.W.; Harvey, J.R. (Oak Ridge National Lab., TN (USA); Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). 1982. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01. Order Number DE82022341.

From Nuclear data for science and technology international conference; Antwerp, Belgium (6 Sep 1982).

Portions of document are illegible.

Neutron transmission measurements have been made on high-purity, highly-enriched samples of ^{58}Ni (99.9%), ^{60}Ni (99.7%), ^{64}Zn (97.9%) and ^{184}W (94.5%) to measure their neutron windows and to assess their potential usefulness for producing monoenergetic beams of intermediate energies from a reactor. Transmission measurements on the Los Alamos Sc filter (44.26 cm Sc and 1.0 cm Ti) have been made to determine the characteristics of the transmitted neutron beam and to measure the total cross section of Sc at the 2.0 keV minimum. When corrected for the Ti and impurities, a value of 0.35 +- 0.03 b was obtained for this minimum.

62345 **(CONF-820942—8) Solid-state effects on thermal-neutron cross sections and on low-energy resonances.** Harvey, J.A.; Mook, H.A.; Hill, N.W.; Shahal, O. (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE82022342.

From Nuclear data for science and technology international conference; Antwerp, Belgium (6 Sep 1982).

The neutron total cross sections of several single crystals (Si, Cu, sapphire), several polycrystalline samples (Cu, Fe, Be, C, Bi, Ta), and a fine-powder copper sample have been measured from 0.002 to 5 eV. The Cu powder and polycrystalline Fe, Be and C data exhibit the expected abrupt changes in cross section. The cross section of the single crystal of Si is smooth with only small broad fluctuations. The data on two single Cu crystals, the sapphire crystal, cast Bi, and rolled samples of Ta and Cu have many narrow peaks approx. 10^{-3} eV wide. High resolution (0.3%) transmission measurements were made on the 1.057-eV resonance in ^{240}Pu and the 0.433-eV resonance in ^{180}Ta, both at room and low temperatures to study the effects of crystal binding. Although the changes in Doppler broadening with temperature were apparent, no asymmetries due to a recoilless contribution were observed.

62346 **(EUR—7086-EN) Gamma ray buildup factors in lead-iron and iron-lead shields.** Penkuhn, H. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1980. 22p. NTIS, PC A02/MF A01.

Using the gamma transport code PIPE, buildup factors are evaluated in shields consisting of: iron layers of up to 40 cm thickness followed by thick lead layers and lead layers of up to 10 cm thickness followed by thick iron layers. The source is assumed plane isotropic and four source energies were used, ranging from 0.66 MeV (caesium source) to 6 MeV. The differences between the buildup factors for exposure and equivalent dose rates are outlined. A comparison of the buildup factors in the iron-lead sequence and the lead-iron sequence shows the latter configuration to present fewer problems.

62347 **(FEI—1198) Search for optimal parameters of a semiempirical model of radiation transmission in shielding.** Dubinin, A.A.; Kurachenko, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702526.

The problem of increasing accuracy of calculation of characteristics of shielding from radiation by the method "extraction + diffusion" by means of determining optimal values of derivation cross sections is considered. As reference point values of shielding characteristics-functionals the calculation results by one of DSsub(n)-method versions are used. The search for optimal parameters of the semiempirical model is performed by the method of "sliding admission". The results of solution of specific problems of group cross sections set optimization of derivation in the course of neutron transmission in a spheric uniform shielding composition are presented. Group values of neutron flux densities on the composition external surface obtained by the ROZ-6 and REMP programs are given.

62348 **(FEI—1214) Boundary conditions in the method of spherical harmonics consistent with the boundary conditions of the Ivon-Mertence type methods.** Polivanskij, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1981. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702527.

A new approach to the derivation of boundary conditions for the spherical harmonics method in Psub(N) approximation is considered. The approach is based in the Yvon-Mertence ideas employing expansion of the function in question into a binary series with respect to the Legendre polynomials with the expansion coefficients defined at corresponding semiintervals of the angular variable μ variations. In the case the boundary conditions for the ex-

pansion coefficients, are unambigously formulated. The boundary conditions for odd approximations of the spherical harmonics method are derived on the example of the one-speed neutron transport in a plane slab. As an example the boundary conditions for the P_3 approximation are explicitly put down.

62349 **(JINR—R-1-81-599) Distribution of ionization losses in electron-photon showers produced by gamma quanta with Esub(γ)=(600-2700) MeV energy in liquid xenon.** Banterrek, A.; Vavzhinskij, Yu.; Slovinskij, B.; Chaj, V.; Okhrimenko, L.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1981. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702528.

The electron and positron ranges of electron-photon showers produced by gamma quanta with the Esub(γ)=(600-2700) MeV energy in liquid xenon have been measured. The experimental data are approximated by the function obtained previously which describes the spatial structure of ionization losses of shower electrons and positrons. Using the large volume of the experimental material more precise values of parameters of the formula have been obtained.

62350 **(JINR—R-14-81-629) Scattering of neutrons by hydrogen and deuterium adsorbed on the surface of nickel catalysts.** Belushkin, A.V.; Natkaniec, I.; Mayer, J.; Stockmeyer, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1981. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702695.

The inelastic neutron scattering and neutron diffraction spectra of hydrogen and deuterium adsorbed on nickel catalysts are measured in order to investigate the frequency distribution function and structure of adsorbed layer. The investigation has been made for different, including small, surface coverages. The measurements were performed by the time-of-flight method with the KD-SOG spectrometer at the IBR-30 reactor. The results of inelastic neutron scattering are compared with the optical spectroscopy data. The analysis of the data obtained for small hydrogen loading in frame of the lattice dynamics model with one H atom bound with 4 Ni atoms on (100) plane leads to the force constant fsub(NiH)=8x10sup(3) dyn/cm characterizing NiH interaction and fsun(HH)=4x10sup(3) dyn/cm for the H-H interaction. The diffraction data allow us to suggest that some amount of hydrogen are dissolved in the nickel lattice.

62351 **(JINR-D—1-81-592) Radiation of 10 GeV positrons channeling in silicon monocrystal.** Golovatyuk, V.M.; Ivanchenko, I.M.; Kadyrov, R.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1981. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702693.

The radiation accompanying the 10 GeV positron planar channeling in a perfect silicon single crystal has been measured. This radiation is found to be narrowly peaked in angular and energy distributions.

62352 **(LBL—14489) Zero-field spin relaxation of the positive muon in copper.** Clawson, C.W. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 102p. NTIS, PC A06/MF A01. Order Number DE82020542.

Thesis.

The spin relaxation of the μ^+ in high purity single crystal and polycrystalline copper has been measured at temperatures between 0.5°K and 5.2°K by the zero-field μ^+SR technique. In both types of sample the experiments show a temperature independent dipolar width Δ/sub z/ = 0.389 +- 0.003 μs^{-1} and a hopping rate decreasing from ~ 0.5 μs^{-1} at 0.5°K to ~ 0.05 μs^{-1} above 5°K. This is the first direct proof of a dynamic effect in the low temperature μ^+ spin relaxation in copper. The relationship between the zero-field and transverse-field dipolar widths is discussed, and the measured zero-field width is found to be ~ 10% larger than expected based on the known transverse-field widths. A new μ^+SR spectrometer has been constructed and used in this work. The spectrometer and the associated beam lines and data acquisition facilities are discussed.

62353 **Free-electron-gas approximation for the stopping power of ionic targets.** Peek, J.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] A: General Physics;* **26**: No. 2, 1030-1034(Aug 1982).

The use of free-electron-gas (FEG) motivated theories, proposed by Lindhard and colleagues, has proved extremely successful in treating the stopping power of neutral targets, and their relatively modest requirements of computational effort has led to their recent application to the stopping by electrons bound to target ions in plasmas. The FEG approximation for the average-excitation-energy Bethe-Born parameter is shown, for hydrogenic targets with nuclear-charge Z, to be Z/sup 3/2/ times the neutral hydrogen value instead of having the correct Z^2 proportionality constant. Numerical data are presented for Al/sup q/+ that show the FEG error obeys this rule and, while the error approaches zero for q = 0, it is substantial for all q>0. An empirical adjustment of the FEG theory is found that reproduces the accurate Al/sup q/+ average-excitation-energy data. Two empirical rules now in use are observed to differ markedly from each other and from the accurate Al/sup q/+ results. The use of the standard FEG theory for all incident projectile energies is questioned on the basis of these results and the augmented theory proposed here requires further testing.

62354 **Diminished stopping power for fast nitrogen and oxygen diclusters in carbon.** Steuer, M.F.; Gemmell, D.S.; Kanter, E.P.; Johnson, E.A.; Zabransky, B.J. (Argonne National Lab., IL (USA)). *Nuclear Instruments and Methods in Physics Research;* **194**: No. 1-3, 277-279(15 Mar 1982).

From 9. international conference on atomic collisions in solids; Lyon, France (6 - 10 Jul 1981).

Stopping powers have been measured for N_2^+ and N^+ ions of 0.5 to 1.8 MeV/atom, for O_2^+ and O^+ ions of 1.0 and 1.6 MeV/atom, $^3He_2^+$ and $^3He^+$ of 1.0 MeV/atom and H_2^+ and H^+ of 0.4 MeV/atom in 2-19 $\mu g/cm^2$ carbon targets. The ratio of the stopping power for the molecular ion to the sum of the stopping powers for the separated atomic components (stopping power ratio) was consistently less than one for the nitrogen and oxygen ions and greater than one for the faster helium and hydrogen ions. The results for hydrogen ions are consistent with those reported earlier from other laboratories. The results for nitrogen, oxygen and helium are new.

62355 **The transport of 14-MeV neutrons through heavy materials.** Hansen, L.F.; Komoto, T.T.; Pohl, B.A.; Wong, C. (LLNL, Livermore, CA 94550). *Transactions of the American Nuclear Society;* **38**: 567(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62356 **Tools for examining ENDF/B data prepared for Monte Carlo calculations.** Estes, G.P.; Little, R.C.; Seamon, R.E.; Young, P.G. (LANL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **38**: 568-570(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62357 **Delayed photon spectra from ENDF/B-V fission product data.** England, T.R.; George, D.C.; LaBauve, R.J. (LANL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **38**: 580(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62358 **Neutron activation and decay data for decay-dominated applications.** Muir, D.W. (LANL, Los Alamos,NM 87545). *Transactions of the American Nuclear Society;* **38**: 597-598(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62359 **Delayed photon sources for shielding applications.** George, D.C.; England, T.R.; LaBauve, R.J.; Marynard, C.W. (LASL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **35**: 463-465(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

6550 Medical Physics

REFER ALSO TO CITATION(S) 62096

62360 **(BNL—31777) Calibration of proportional counters in microdosimetry.** Varma, M.N. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 11p. (CONF-820931—5). NTIS, PC A02/MF A01. Order Number DE82022048.

From 8. symposium on microdosimetry; Julich, F.R. Germany (27 Sep 1982).

Many microdosimetric spectra for low LET as well as high LET radiations are measured using commercially available (similar to EG and G) Rossi proportional counters. This paper discusses the corrections to be applied to data when calibration of the counter is made using one type of radiation, and then the counter is used in a different radiation field. The principal correction factor is due to differences in W-value of the radiation used for calibration and the radiation for which microdosimetric measurements are made. Both propane and methane base tissue-equivalent (TE) gases are used in these counters. When calibrating the detectors, it is important to use the correct stopping power value for that gas. Deviations in y-bar/sub F/ and y-bar/sub D/ are calculated for ^{60}Co using different extrapolation procedures from 0.15 keV/μm to zero event size. These deviations can be as large as 30%. Advantages of reporting microdosimetric parameters such as y-bar/sub F/ and y-bar/sub D/ above a certain minimum cut-off are discussed.

62361 **(LBL—14779) Heavy charged-particle beam dosimetry.** Lyman, J.T. (Lawrence Berkeley Lab., CA (USA)). Jun 1982. Contract AC03-76SF00098. 21p. (CONF-8206113—1). NTIS, PC A02/MF A01. Order Number DE82020315.

From IAEA meeting on advances in dosimetry for fast neutrons and heavy charged-particles for therapy applications; Vienna, Austria (14 Jun 1982).

A computational description of the physical properties and the beam composition of a heavy charged-particle beam is presented. The results with this beam model has been compared with numerous sets of experimental data and it appears to provide an adequate representation of the major features of a heavy charged-particle beam. Knowledge of the beam composition aids in the identification of regions of the beam where special dosimetry problems may be encountered.

62362 **Performance of nuclear criticality accident dosimetry systems.** Sims, C.S.; Swaja, R.E. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **38**: 586-587(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62363 **Provision of national standards of absorbed dose for radiation processing. The role of NPL in the United Kingdom.** Ellis, S.C. (National Physical Lab., Teddington (UK)). pp 7-16 of High-dose measurements in industrial radiation processing. Report of an advisory group meeting on standardization and high-dose intercomparison for industrial processing organized by the IAEA and held in Vienna, 25-29 September 1978. Vienna, Austria; International Atomic Energy Agency (1981).

From IAEA meeting on standardization and highdose intercomparison for industrial radiation processing; Vienna, Austria (25 Sep 1978).

The system of national and international standardization is examined, particularly with respect to the problems of standardizing high absorbed dose measurements required in processing with photons from cobalt-60 and electrons. The need for development of primary standards specifically dedicated to this application versus the possibility of extrapolation from standards in use at lower dose levels is considered together with means for dissemination and intercomparison. The present status of standards at NPL and the future programme are outlined.

62364 **National standardization programme for high-dose measurements.** McLaughlin, W.L. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). pp 17-32 of High-dose measurements in industrial radiation processing. Report of an advisory group meeting on standardization and high-dose intercomparison for industrial processing organized by the IAEA and held in Vienna, 25-29 September 1978. Vienna, Austria; International Atomic Energy Agency (1981).

From IAEA meeting on standardization and highdose intercomparison for industrial radiation processing; Vienna, Austria (25 Sep 1978).

A variety of dose meter calibration services is provided by NBS to industrial radiation users of intense radiation fields, in particular, large gamma-ray sources and electron accelerators at energies up to approximately 4MeV. The services include the administering of known doses of ionizing photons and electrons to users' dose meters, supplying calibrated secondary-standard transfer dose meters and subsequent read-out and dose interpretation after irradiation, and special calibration services such as the determination of temperature dependence, rate dependence, or reproducibility of dose meter response and measurement of detailed dose distributions in specific irradiation geometries and in selected absorbing materials. The latter can, in fact, include dose profiles in heterogeneous absorbers and at surfaces and interfaces of different substances. Such information is important in research leading to the commissioning of a radiation process, in the commissioning dosimetry itself and, in some instances, in measurement assurance as it provides quality control of a given radiation treatment.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 61818, 62258, 62352

62365 **(CONF-810851—5) Electronic structure of metallic glasses.** Oelhafen, P.; Lapka, R.; Gubler, U.; Krieg, J.; DasGupta, A.; Guentherodt, H.J.; Mizoguchi, T.; Hague, C.; Kuebler, J.; Nagel, S.R. (Oak Ridge National Lab., TN (USA); Basel Univ. (Switzerland). Inst. fuer Physik; Gakushuin Univ., Tokyo (Japan). Dept. of Physics; Paris-6 Univ., 75 (France). Lab. de Chimie Physique; Technische Hochschule Darmstadt (Germany, F.R.); Chicago Univ., IL (USA). James Franck Inst.). 1981. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE82020934.

From 4. international conference on rapidly quenched metals; Sendai, Japan (24 Aug 1981).

This paper is organized in six sections and deals with (1) the glassy transition metal alloys, their d-band structure, the d-band shifts on alloying and their relation to the alloy heat of formation (ΔH) and the glass forming ability, (2) the glass to crystal phase transition viewed by valence band spectroscopy, (3) band structure calculations, (4) metallic glasses prepared by laser glazing, (5) glassy normal metal alloys, and (6) glassy hydrides.

62366 **(CONF-811253—Pt.2) Silver Jubilee physics symposium. Volume 24C.** (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). 1981. 677p. Dep. NTIS (US Sales Only), MF A01. Order Number DE82905331.

From Silver jubilee physics symposium; Bombay, India (28 Dec 1981).

Portions of document are illegible.

This section of the proceedings of this twenty-fifth Nuclear Physics and Solid State Physics Symposium covers solid state theory, defects and radiation damage, disordered materials and liquids, electron states and energy bands, lattice dynamics, low temperature physics and superconductivity, magnetic properties, me-

chanical and acoustic properties, phase transitions and critical phenomena, quantum fluids and solids, resonance studies and relaxation phenomena, semiconductors, techniques and instrumentation, and transport properties and non-equilibrium phenomena. (GHT)

62367 **(ITF—82-74P) Biomolecular damping of incoherent excitons when the diffusion and the Forster mechanisms of the excitation transfer coexist.** Gaididei, Yu.B.; Onipko, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Jun 1982. 26p. (In Russian). Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR.

On the basis of a chain of equations of the Bogolyubov type an expression for the recombination rate of incoherent excitons is obtained in the case of a multipole-multipole interaction. It is shown that there exist three regions, defined by the relation between Forster's radius of interaction and the exciton diffusion length, where the dependence of the recombination rate on the parameters of an exciton system is qualitatively different.

62368 **(ITF—82-79P) Temperature dependence of nonlinear luminescence damping in molecular crystals.** Gaididei, Yu.B.; Onipko, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Jun 1982. 15p. (In Russian). Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR.

It is shown that the temperature dependence of the singlet-singlet exciton annihilation rate constant observed in naphthalene crystals is explained by two limiting processes: the small rate of a transition into the biexciton state at low temperatures and the small diffusion rate at high temperatures.

62369 **(ITF—82-84P) Quasi-particle diffusion in nonlinear media.** Gaididei, Yu.B. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Jun 1982. 18p. (In Russian). Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR.

The motion of quasi particles that interact with an elastic crystal subsystem is studied under strong transversal relaxation. The density of the probabilities to find the particle at a given point in the space is governed by the nonlinear equation of diffusion. The solution of this equation are analyzed and it is shown that the quasi particles are localized in nonlinear media.

62370 **(ITF—82-99E) Theory of the isotropic magnetoelastic gap.** Gaididei, Yu.B.; Loktev, V.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Jul 1982. 14p. Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR.

The problem of a gap in the spectrum of spin waves of magnetic easy-plane-type crystals is considered. The conditions under which the FMR (AFMR) frequency as a function of an external magnetic field tends to zero when the field vanishes are found.

62371 **(ITF—82-IIIP) Soliton excitation in one-dimensional molecular systems.** Brizhik, L.S.; Davydov, A.S. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Jun 1982. 33p. (In Russian). Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR.

The presence (or absence) of the soliton excitation threshold and the threshold value are shown to be dependent on the character of excitation distribution at an initial time moment. The excitation time evolution which is given initially as a hyperbolic secant, a rectangular step and a decreasing exponent is investigated.

62372 **(UCRL—87400) Modeling of current and thermal mode second breakdown phenomena.** Yee, J.H.; Orvis, W.J.; Martin, L.C.; Peterson, J.C. (Lawrence Livermore National Lab., CA (USA)). 13 Sep 1982. Contract W-7405-ENG-48. 7p. (CONF-820946—1). NTIS, PC A02/MF A01. Order Number DE82020965.

From 4. annual electrical overstress/electrostatic discharge symposium; Orlando, FL, USA (21 Sep 1982).

Portions of document are illegible.

We have used a computer code which solves the transport equations for electrons and holes in conjunction with the heat transfer equation, to investigate current mode and thermal second breakdown (CSB and TSB). For an epitaxial transistor, we have calculated the average failure threshold power and the average failure threshold energy, as a function of the delay time to failure for different external resistances. We show that, because of the existence of two types of breakdown phenomena, the threshold power and threshold energy curves are not a continuous function of the delay times. We have calculated the evolution of the electric fields and the densities of holes and electrons as a function of space and time during current mode second breakdown. And, we have investigated the temporal behavior of the temperature during second breakdown. Finally, we present some preliminary experimental results concerning the threshold power for breakdown.

62373 **Determination of dipole coupling constants using heteronuclear multiple quantum NMR.** Weitekamp, D.P.; Garbow, J.R.; Pines, A. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **77**: No. 6, 2870-2883(15 Sep 1982).

The problem of extracting dipole couplings from a system of N spins I = 1/2 and one spin S by NMR techniques is analyzed. The resolution attainable using a variety of single quantum methods is reviewed. The theory of heteronuclear multiple quantum (HMQ) NMR is developed, with particular emphasis being placed on the superior resolution available in HMQ spectra. Several novel pulse sequences are introduced, including a two-step method for the excitation of HMQ coherence. Experiments on partially oriented [1-^{13}C] benzene demonstrate the excitation of the necessary HMQ coherence and illustrate the calculation of relative line intensities. Spectra of high order HMQ coherence under several different effective Hamiltonians achievable by multiple pulse sequences are discussed. A new effective Hamiltonian, scalar heteronuclear recoupled interactions by multiple pulse (SHRIMP), achieved by the simultaneous irradiation of both spin species with the same multiple pulse sequence, is introduced. Experiments are described which allow heteronuclear couplings to be correlated with an S-spin spreading parameter in spectra free of inhomogeneous broadening.

62374 **Monte Carlo renormalization-group study of the Baxter-Wu model.** Novotny, M.A.; Landau, D.P.; Swendsen, R.H. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). *Physical Review [Section] B: Condensed Matter;* **26**: No. 1, 330-336(1 Jul 1982).

The effectiveness of a Monte Carlo renormalization-group method is studied by applying it to the Baxter-Wu model (Ising spins on a triangular lattice with three-spin interactions). The calculations yield three relevent eigenvalues in good agreement with exact or conjectured results. We demonstrate that the method is capable of distinguishing between models expected to be in the same universality class, when one of them (four-state Potts) exhibits logarithmic corrections to the usual power-law singularities and the other (Baxter-Wu) does not.

6561 Superconductivity

REFER ALSO TO CITATION(S) 61777, 61779, 61785, 61797

62375 **Coherence length of a normal metal in a proximity system.** Kogan, V.G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **26**: No. 1, 88-98(1 Jul 1982).

The Eilenberger equations are solved to find the correlation length in the normal (N) part of a proximity system at a temperature T which is well above the critical temperature T/sub c/N and is not too far below T/sub c/S (T/sub c/N<T< or ≈T/sub cS/). The result is valid for any concentration of nonmagnetic impurities.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 61603, 62273, 62548

62376 (CONF-810842—6) Transformed beta distribution and its application in distribution fitting. Lam, H.K.; Bowman, K.O.; Shenton, L.R. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.; Chinese Univ. of Hong Kong, Shatin. Mathematics Dept.; Georgia Univ., Athens (USA). Office of Computing and Information Service). 1981. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01. Order Number DE82020918.

From American Statistical Association meeting; Detroit, MI, USA (10 Aug 1981).

Portions of document are illegible.

We consider the transformation Y = α + β[X/sup γ/ - (1 - X) /sup δ/], - infinity < α, β,γ,δ < infinity, on the beta variate X which has the p.d.f. f(x) = x/sup p-1/(1 - x)/sup q-1//B (p, q), 0 ≦ x ≦ 1, where B(p, q) is the beta function. This family includes a number of well-known distribution functions, one of them is the generalized Tukey's lambda distribution. Using this family of distributions as base, moment models are constructed for the theoretical distribution of sample statistics. Significance of these models is: Producing the correct range in the distribution of the statistics, consistent with the asymptotic normality of the statistics, and in some models higher order standard moments up to β_4 are used.

62377 (HU-TFT—81-38) Quantum revivals in the motion of electron in magnetic field. Filipowicz, P.; Mostowski, J. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 16 Sep 1981. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702687.

We show that the motion of a relativistic electron in constant homogeneous magnetic field exhibits quasiperiodic behaviour (quantum revivals) and discuss the possibility of their observation.

62378 (JINR—E-2-81-608) Complex-potential description of the damped harmonic oscillator. Pt. 1. The propagator. Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702688.

Multidimensional damped harmonic oscillator is treated by means of a non-selfadjoint Hamiltonian with complex potential. The latter is chosen as V(x)=xx(A-iW)x with positive matrices A, W, By a perturbation-theory argument, the corresponding Hamiltonian H=-1/2Δ+V with the natural domain is shown to be closed and such that Vsub(t)=exp(-iHt) is a continuous contractive semigroup. Explicit integral-operator form of Vsub(t) is found by use of Lie-Trotter formula.

62379 (JINR—R-5-81-188) Bogolubov-Ruelle theorem: a new proof and generalizations. Zagrebnov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702689.

Proof of the existence of the marginal Gibbs distribution, or marginal correlation functions, in the case when the system volume approaches infinity, is one of the major problems of classical statistical mechamics. A new proof Bogolubov-Ruelle theorem, i. e. proof of the existence and the uniqueness of marginal correlation functions for continuous systems, is proposed. The method is based on the application of the Banach space dual pair <'Esub(xi), Esub(xi)> and makes it possible to do away with routine cumbersome evaluations reducing the range of theorem applicability to the analiticity ring. The case of a large canonical ensemble and nontrivial boundary conditions is treated. The convergence to marginal correlation functions is shown to take place in the region, containing the analiticity ring, the margin being unique, analytic by activity and independent of the boundary conditions.

62380 (UCID—19565) Fast inverse EOS lookup techniques with radiation. Warshaw, S.I. (Lawrence Livermore National Lab., CA (USA)). 5 Aug 1976. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01. Order Number DE83000745.

Portions of document are illegible.

In radiation-hydro codes using both temperature and energy as variables, it frequently becomes necessary to convert from one to the other and back again. These conversions usually rely on the establishment of a well-defined equation of state, for which the inverse is not conveniently available. For example, material specific internal energy is generally set up as a function of the material temperature θ and density rho, viz.: ϵ/sub m/(rho, θ), but the inverse function θ(rho, ϵ/sub m/) is not. To obtain θ given ϵ/sub m/ and rho, ϵ/sub m/(rho, θ) is inverted analytically, if that is possible, else recourse must be had to approximate or iterative methods. If one is considering situations where matter and radiation are in thermodynamic equilibrium, the energy equation of state can be remodeled to include radiation energy, by writing ϵ(rho, θ) = ϵ/sub m/ (rho, θ) + aθ^4/rho where a is a constant. A few, faster iterative schemes to calculate θ from the radiation-augmented energy equation of state are presented in which the number of iterations (and therefore the number of ϵ/sub m/(rho, θ) calculations) required to satisfy a given accuracy criterion appears to be minimal. These schemes converge rapidly, and, as will be shown below in certain specific examples, reach a very respectable accuracy in about three iterative passes or less. Whether or not radiation dominates does not seem to be a major factor.

62381 Particle distribution functions of lattice gases. Johnson, E.M.C. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Journal of Chemical Physics;* **77**: No. 6, 3238-3245(15 Sep 1982).

An apparently exact variational method for obtaining the three-particle distribution function of classical, pairwise additive potential energy function systems from the pair distribution function is used to treat two- and three-dimensional lattice gases. The results obtained strongly support the view that the variational method is exact. This method is also used in conjunction with the integrated Buff—Brout equation to obtain the pair and the three-particle distribution functions of two-dimensional lattice gases from the interparticle interactions.

62382 Asymptotic properties of coupled nonlinear Langevin equations in the limit of weak noise. I: Cusp bifurcation. Van den Broeck, C.; Mansour, M.M.; Baras, F. (Aspirant NFWO, Vrije Universiteit Brussel, Pleinlaan 2. 1050 Bruxelles, Belgium). *Journal of Statistical Physics;* **28**: No. 3, 557-576(Jul 1982).

We show how a singular perturbation technique based on the introduction of properly scaled variables enables us to derive the asymptotic properties of coupled Langevin equations in the limit of weak noise. This technique can be applied when the macroscopic steady state is asymptotically or marginally stable. In the close vicinity of a cusp bifurcation point, a simple prescription for the adiabatic elimination of the fast variable is established. The critical variable exhibits amplified non-Gaussian fluctuations on a slow time scale. The properties of the fast variable depend on the nonlinearity of the system under consideration. Because of its coupling to the critical variable, it may exhibit amplified fluctuations of non-Gaussian nature.

62383 Asymptotic properties of coupled nonlinear Langevin equations in the limit of weak noise. II: Transition to a limit cycle. Baras, F.; Mansour, M.M.; Van den Broeck, C. (Universite Libre de Bruxelles, Faculte des Sciences, Campus Plaine, C. P. 231, 1050 Bruxelles, Belgium and Boursier I. R. S. I. A.). *Journal of Statistical Physics;* **28**: No. 3, 577-602(Jul 1982).

We apply the singular perturbation technique, developed in the companion paper, to the study of the fluctuations at the onset of a limit cycle, both for the cases of a soft and a hard transition. The technique and results are illustrated on the Poincare model (soft transition) and on the Van der Pol oscillator (hard transition).

62384 Ellipsoid paradox in thermodynamics. Welford, W.T.; Winston, R. (Blackett Laboratory, Imperial College, London SW7 2BZ, England (Visiting Professor at The University of Chicago while this work was done.)). *Journal of Statistical Physics;* **28**: No. 3, 603-612(Jul 1982). Contract AC02-80ER10575.

A resolution of the "ellipsoid paradox in thermodynamics" is proposed based on elementary geometrical optics.

62385 **Non-linear approximation to the Schroedinger time evolution in a truncated subspace.** Schultheis, H.; Schultheis, R.; Volkov, A.B. (Institut fuer Theoretische Physik, Universitaet Tuebingen, D-7400 Tuebingen, W. Germany). *Annals of Physics (New York);* **141**: No. 1, 179-198(Jun 1982).

Approximations to the Schroedinger time evolution in a highly truncated subspace are studied as an alternative to the time-dependent Hartree-Fock approximation. We derive a differential equation of second order in time, that involves the subspace matrix elements of the square of the Hamiltonian. The equation is completely defined and soluble within an arbitrarily truncated subspace. The solutions are non-unitary and allow for a flux of probability between the subspace and the excluded space. The accuracy of the approximation is studied in a number of examples.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 61428, 61429, 61430, 61432, 61433, 61434, 61437, 61439, 61440, 62463, 62567

62386 **(IAE—3396/1) Application of the influence functions and reciprocal matrices in solving mathematical physics problems.** Lobyntsev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1981. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702600.

Analogy between the influence function (continuous analysis), and the reciprocal matrix (discrete analysis) is considered in detail, as well as their application to constructing a reciprocal operator and to other purposes in solving mathematical physics boundary problems. As an example a boundary problem for a second order differential equation of eliptical type is considered. The case of block-type three-diagonal matrices appearing in discrete boundary problems in many-dimensional areas is also considered. It is demonstrated, that for such problems there is no need to determine all the elements of the reciprocal matrix. Therefore, in order to provide the possibility of constructing economical calculational algorithms formulae are derived, which express explicity the dependence of an arbitrary reciprocal matrix element on the matrix elements in question; convenient recurrent relationships are also obtained.

62387 **(JINR—E-2-81-666) Supersymmetric quasipotential equations. 1. Supersymmetric extension of the Log ov-Tavkhelidze approach.** Zaikov, R.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1981. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702601.

A supersymmetric extension of the Logunov-Tavkhelidze quasipotential approach is suggested. The supersymmetric Bethe-Salpeter equation is an initial equation. The transition from the four-time to the two-time Green function is made in the super-center-of-mass system. The two-time Green function has no inverse function in the whole spinor space. The resolvent operator is found using the Majorana character of the spinor wave function. The supersymmetric quasipotential equation is written. The consideration is carried out in the framework of the theory of chiral scalar superfields.

62388 **(LA—9495-MS) Boundary perturbation formalism for Poisson's equation.** Channell, P. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01. Order Number DE82021218.

A formalism for solving Maxwell's equations in near cylindrical geometries by a boundary-perturbation technique is presented. The formalism should be easy to implement numerically.

62389 **Boundary value problems of mixed type arising in the kinetic theory of gases.** Kaper, H.G. (Argonne National Lab., IL). *SIAM (Society for Industrial and Applied Matheatics) Journal of Mathematical Analysis;* **10**: No. 1, 161-178(Jan 1979).

The linear integro-differential transport equation is interpreted in functional form as a relation in a weighted Hilbert space $L_2(R, \mu)$. It is shown that this equation, together with the appropriate boundary conditions, defines a well-posed problem in $L^2(R, \mu)$

62390 **Spectral representation of an unbounded linear transformation arising in the kinetic theory of gases.** Kaper, H.G. (Argonne National Lab., IL). *SIAM (Society for Industrial and Applied Matheatics) Journal of Mathematical Analysis;* **10**: No. 1, 179-191(Jan 1979).

The linear integro-differential transport equation is interpreted in functional form as an ordinary differential equation for the mapping in a weighted Hilbert space $L_2(R, \mu)$. In the article Boundary value problems of mixed type arising in the kinetic theory of gases the author proved the existence of a diagonalizing transformation for the (unbounded) evolution operator associated with the differential equation. In the present article explicit representations for this transformation are established.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 61434

62391 **(AD-A—112377/7) Waves and instabilities in steady-state high beta plasmas. Final scientific report.** Luhmann, N.C. Jr. (California Univ., Los Angeles (USA). Dept. of Electrical Engineering). Dec 1981. 56p. (UCLA-ENG—81-48). NTIS, PC A04/MF A01.

Experimental simulations of laser-plasma interactions have been performed in the microwave region. Stimulated Brillouin scattering from transient density perturbations associated with the finite (1%) chamber reflectivity has been observed. Saturation of the reflectivity has been observed at approximately 5% and the saturation mechanism identified as ion tail heating. The experimental results are in excellent agreement with numerical calculations of the density fluctuations and reflectivity which account for electron main body heating via inverse Bremsstrahlung absorption and ion tail heating. For the first time ion waves have been generated by optical mixing. The experimental results in the linear region were shown to be in excellent agreement with theoretical predictions. The saturation level was found to be identical to that seen in the pure SBS studies and shown to be also due to ion tail heating. Studies were made of resonance absorption produced electric fields and the associated hot electron production. At the lowest intensity levels the saturation was shown to be due to plasma wave convection out of the critical layer while at higher intensities it was due to cold plasma wavebreaking. Finally, finite bandwidth effects were investigated.

62392 **(CONF-810754—4) Effects of low-energy-electron-capture collisions (H_0 + c/sup n+/) on the particle and energy balance of tokamak plasmas.** Hogan, J.T. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01. Order Number DE82018263.

From 12. IPEAC international conference on the physics of electronics and atomic collisions; Gatlinburg, TN, USA (15 Jul 1981).

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To illustrate the way in which atomic data provides enlightenment in the search for understandable (and thus extrapolable) confinement models, we restrict our scope to electron capture collisions involving H_0 and multiply-charged ions. Many such foreign (impurity) multiply-charged ion species are found in plasma discharges, as a result of gas recycling and damage to the surrounding surfaces by energetic plasma particles. Typical low-Z ions are carbon and oxygen; the major constituents of the stainless steel wall (Fe, Ni, Cr) are intermediate impurities, while high-Z impurities (Mo, W) enter from limiter plates which constrict the hot plasma zone to reduce direct plasma-wall contact. In this discussion, however, attention will be given only to applications of data involving H_0 + C/sup n+/ $\rightarrow$ H^+ + C/sup (n-1)+/ reactions with energy 10 eV to 2 keV. This energy range is typical of the plasma edge in present devices.

62393 **(CONF-810831—96) Effects of neutral-beam injection and gas puffing on deuterium and impurity levels in the scrapeoff layer of ISX-B.** Zuhr, R.A.; Roberto, J.B.; Withrow, S.P. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE82020920.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Plasma-material interactions in the scrapeoff region of a tokamak have important effects on the overall performance of the machine. In order to prudently select the most-appropriate materials for walls, limiters, and armor plate, it is necessary to characterize the plasma that interacts with these surfaces and to understand what effect different modes of operation of the tokamak have on plasma characteristics. We have made a series of measurements on the ISX tokamak using deposition-probe techniques to identify and quantify the impurities ($Z \geqq 8$) in the limiter shadow, and to determine the temporal behavior of both impurity and plasma particles in this region. These measurements have been made under a variety of tokamak operating conditions, including both ohmic and neutral-beam heated discharges. The results are interpreted in terms of edge conditions, impurity introduction, gas puffing, and the relative importance of wall and limiter contributions.

62394 **(CONF-820930—17) Beta-scaling experiments in ISX-B.** (Oak Ridge National Lab., TN (USA)). 1982. Contract W-7405-ENG-26. 2p. NTIS, PC A02/MF A01. Order Number DE82022261.

From 9. international conference on plasma physics and controlled nulcear fusion research; Baltimore, MD, USA (1 Sep 1982).

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High beta studies in ISX-B ($R = 0.93$m, $a = 0.26$m, $1.1 \leqq b/a \leqq 1.6$, I/sub p/ = 60-230kA, B/sub T/ = 0.75-1.5T, anti n/ sub e/ $\leqq 1.1 \times 10^{20} m^{-3}$, P/sub b/ $\leqq$ 2.5MW) have been aimed at understanding the nonlinear increase of β with beam power that results from deteriorating confinement at high beam power ($< \beta > = 2.5\%$ as opposed to the expected 4% with 2.5 MW injection).

62395 **(CONF-820944—5) X-ray spectroscopy on tokamaks.** von Goeler, S.; Bitter, M.; Cohen, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1982. Contract W-7405-ENG-26. 41p. NTIS, PC A03/MF A01. Order Number DE82022242.

From Workshop on diagnostics for fusion reactor conditions; Varenna, Italy (6 Sep 1982).

Portions of document are illegible.

During the last decade, the x-ray spectroscopy of high temperature plasmas has witnessed a rapid development. Most of the impulses have come from astrophysics, in particular, from the research on solar flares. On the other hand, the attainment of well-diagnosed, high-temperature laboratory plasmas in laser-pellet implosions and in tokamaks, has precipitated a fertile exchange between theory and experiment. Agreement and very detailed understanding has been reached for a great number of spectra with the result, that x-ray spectroscopy represents today a powerful and reliable new plasma diagnostic with important applications for fusion plasmas as well as solar flares. This paper is a short review of the experimental results from tokamaks.

62396 **(CONF-821103—16) Variance-reduction technique for Coulomb-nuclear thermalization of energetic fusion products in hot plasmas.** DeVeaux, J.C.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1982. Contract AC02-76ET52040. 6p. (COO—2218-250). NTIS, PC A02/MF A01. Order Number DE82020203.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

A variance-reduction technique involving use of exponential transform and angular-biasing methods has been developed. Its purpose is to minimize the variance and computer time involved in estimating the mean fusion product (fp) energy deposited in a hot, multi-region plasma under the influence of small-energy transfer Coulomb collisions and large-energy transfer nuclear elastic scattering (NES) events. This technique is applicable to high-temperature D-^{3}He, Cat. D and D-T plasmas which have highly energetic fps capable of undergoing NES. A first application of this technique is made to a D-^{3}He Field Reversed Mirror (FRM) where the Larmor radius of the 14.7 MeV protons are typically comparable to the plasma radius (plasma radius $\sim$ 2 fp gyroradii) and the optimistic fp confinement ($\sim$ 45% of 14.7 MeV protons) previously predicted is vulnerable to large orbit perturbations induced by NES. In the FRM problem, this variance reduction technique is used to estimate the fractional difference in the average fp energy deposited in the closed-field region, E/sub cf/, with and without NES collisions.

62397 **(CONF-821103—17) Simulation studies of anomalous slowing down of fusion products.** Sutton, W.R.; Choi, C.K.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1982. Contract AC02-76ET52040. 6p. (COO—2218-247). NTIS, PC A02/MF A01. Order Number DE82020181.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

Future fusion reactors will rely on fusion product heating of the plasma for ignited (or near-ignited) operation. One factor that could drastically change such operation would be if the fusion product alpha initiates microinstabilities during slowing down. In addition to changing heating rates, this can result in a preferential transfer of energy to fuel ions as the alphas slow down and a reduction in the bombardment of the wall by high energy alphas. While considerable theoretical effort has been devoted to studies of such instabilities, the situation remains clouded. It appears that full resolution of the issues involved requires an experiment. The purpose of the present paper is to identify conditions where simulation experiments might be carried out in existing experimental devices, avoiding the need to wait for a burning plasma experiment.

62398 **(DOE/ER/53104—3) ECRH and transport modeling in tandem mirrors and divertor physics. Task II. Annual progress report on fusion plasma theory, January 1-September 31, 1982.** Emmert, G.A. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Aug 1982. Contract AC02-80ER53104. 11p. NTIS, PC A02/MF A01. Order Number DE82021052.

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A summary of work during this period is given for the following: ecrh and transport modeling in tandem mirrors and divertor physics. (MOW)

62399 **(DOE/ER/53104—4) Annual progress report on an investigation of auxiliary heating in tandem mirrors and tokamaks for the period January 1, 1982-December 31, 1982.** Scharer, J.E. (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering). Jul 1982. Contract AC02-80ER53104. 8p. NTIS, PC A02/MF A01. Order Number DE82020896.

The research has focused on physics questions concerned with ECRF heating in tandem mirror plugs and barriers and ICRF coupling and heating in tokamaks. We have utilized a three-dimensional weakly relativistic (T/sub e/ $\leqq$ 50 keV) ray tracing and absorption code we have developed for electron cyclotron heating in tandem mirror plugs and barriers. Cases run for TMX, MFTF-B and reactors at T/sub e/ $>$ 10 keV show that strong absorption per pass is present and a careful choice of wave mode, frequency and launch angle is required to ensure wave penetration and absorption in the plasma core. At elevated electron temperatures (T/sub e/ $>$ 10 keV), ordinary mode launch at $\theta \simeq 70^0$ provides good single pass absorption without the edge absorption problems associated with the extraordinary mode. We have also developed an ICRF 1-D slab model to investigate coupling and heating in tokamak plasmas.

62400 **(DOE/ER/53131—1) Analytical study of transport mechanisms for energetic-ion heating of INTOR-size tokamaks. Quarterly technical report, 2 June-31 August 1982.** Drummond, W.E. (Austin Research Associates, Inc., TX (USA)). Sep 1982. Contract AC05-82ER53131. 49p. (COO—3131-1). NTIS, PC A03/MF A01. Order Number DE82020971.

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The Tokamak and injected ion parameters considered in this survey effort are summarized. The physics involved with the most promising of the methods of transport, namely the grad-B transport

scheme, is examined in detail. Under this analysis, a class of particles is discovered which cannot be transported to the edge of the plasma except through use of magnetically shielded transport systems. The use of shielded transport systems for such particles is discussed and shown to be unfortunately incompatible with known injection requirements. The third transport scheme, that of ballistic transport, is discussed and its limitations noted.

62401 **(DOE/ET/52040—244) Engineering models for α-particle-driven anomalous heating and spatial transport in toroidal devices.** Sutton, W.R. III. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1982. Contract AC02-76ET52040. 57p. (CONF-821103—3; COO—2218-244). NTIS, PC A04/MF A01. Order Number DE82016818.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

Simple physics models are developed which scope the plasma level consequences for both anomalous heating and anomalous spatial transport of fusion products. Both the resonant nature of and energy available for quasi-linear diffusion limit the anomalous heating to significantly less than 100% of the initial α energy. When integrated with the 1 1/2-D tokamak transport code WHIST, these heating and transport models scope the system level effects potentially available. Net power improvement of ≦ 20% may be possible in a fusion engineering type device for both anomalous heating and anomalous spatial transport.

62402 **(DOE/ET/53045—6) Nonlinear magnetohydrodynamics. Progress report, January 1, 1980-December 31, 1982.** Vahala, G.; Montgomery, D. (College of William and Mary, Williamsburg, VA (USA)). 1982. Contract AS05-76ET53045. 16p. NTIS, PC A02/MF A01. Order Number DE82021221.

A list of abstracts is given that summarizes research activities during this period. (MOW)

62403 **(DOE/ET/53051—46) Exhaust-rate measurements in a divertor with large mirror ratio.** Strait, E.J. (Wisconsin Univ., Madison (USA). Dept. of Physics). Aug 1982. Contract AC02-76ET53051. 12p. NTIS, PC A02/MF A01. Order Number DE82020990.

The parallel ion fluid velocity in the scrape-off layer of a poloidal divertor is observed to vary inversely with the mirror ratio in the divertor's throat for ratios ranging from 1 to 5, in good agreement with models developed for bundle divertors. The density variation on a diverted field line also agrees qualitatively with the models, but the observed electric field does not.

62404 **(IAE—3389/6) Simple models of the forced plasma expansion.** Zhidkov, A.G.; Marchenko, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1981. 35p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702611.

The forced expansion of the dense equilibrium plasma, consisting of heasy ions is considered. The forced plasma expansion is understood as the expansion of plasma continuously heated by an external energy source. Volume-averaged dense plasma expansion equations and ion kinetics are considered. Thermodynamic functions of the ideal plasma in the average ion approximation are determined. The dense plasma radiation is considered. In the average ion approximation bremsstrahlung and photorecombination radiation in an intermediate regime of partial reabsorption are taken into account. Time expansion regions with different types of radiation yield are determined. Refinement and development of analytical models of forced expansion, based on the average ion approximation are carried out. In particular, analytical estimates are extrapolated for the case of partial radiation reabsorption. Numerical solutions of plasma expansion equations are presented. Comparison with analytical estimates is carried out.

62405 **(IPF—80-10) Compilation of Rayleigh cross sections for the laser diagnostics of plasmas.** Hirsch, K. (Stuttgart Univ. (TH) (Germany, F.R.)). Oct 1980. 28p. (In several languages). NTIS, PC A03/MF A01.

Fundamental notions of scattering, polarization, and cross sections were reviewed. The experimental scattering and detection set-up is described. Rayleigh data for nine gases were derived which are in excellent agreement with theoretical calculations. Together with established data from the literature, these results are compiled in tables and graphs of differential and total cross sections, ratio of Thomson to Rayleigh cross sections, and equivalent electron density. (ESA)

62406 **(JAERI-M—9653) Measurement of ion species composition and impurity level by Doppler shift spectroscopy.** Okumura, Y.; Ohara, Y.; Shibata, T. (Japan Atomic Energy Research Inst., Tokyo). Sep 1981. 19p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702697.

The ion species composition and impurity level in intense hydrogen beams have been measured by observing the Doppler-shifted Balmer alpha radiation emitted from fast hydrogen atom. These results have been compared with the results obtained by magnetic mass spectrometer and found that those results for species composition were in agreement within ~10%. Oxygen impurities at the level of one percent can be identified by the spectroscopy. The spectroscopy turned out to be an useful method as a beam diagnostic technique.

62407 **(KFTI—81-34) Hydromagnetic plasma stability of the finite pressure in toroidal trap with the spatial magnetic axis.** Demchenko, V.V.; Kravtsov, P.I.; Omel'chenko, A.Ya. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1981. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE82702698.

The effect of ballooning phenomena on plasma stability in a simpliest toroidal magnetic trap of a stellarator type with a spatial magnetic axis (helical solenoid) is analytically studied. Using the small oscillation method the plasma stability criterion with respect to small-sized perturbations with the arbitrary ratio of the lambdasub(a) transverse (along the radius) and lambda$_0$ longitudinal (along the minor torus asimuth) dimensions is determined. It is shown that the plasma self-stabilization effect takes place for the Mercier perturbations (lambdasub(a)<<lambdasub(theta)) for an arbitrary profile of the radial pressure distibution. The contribution in to the stability criterion of stabilizing components caused by accountancy for the perturbation modes with an arbitrary lambdasub(a)/lambdasub(theta) shift (of the anti-Mercier type, in particular) leads to plasma destabilization under conditions of fulfilment of the Mercier criterion Hence, with the pressure increase hydromagnetic plasma stability of small-sized perturbations worsens.

62408 **(LA-UR—82-2340) Dynamical processes in the reversed-field pinch.** Caramana, E.; Cayton, T.; Dagazian, R. (Los Alamos National Lab., NM (USA); Cornell Univ., Ithaca, NY (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1982. Contract W-7405-ENG-36. 13p. (CONF-820930—13). NTIS, PC A02/MF A01. Order Number DE82021771.

From 9. international conference on plasma physics and controlled nulcear fusion research; Baltimore, MD, USA (1 Sep 1982).

This paper presents a review of recent theoretical work on the Reversed-Field Pinch (RFP) at Los Alamos National Laboratory. A wide variety of topics are discussed. These include: nonlinear, two-dimensional, helical, magnetohydrodynamic (MHD) simulations of current-driven modes; a statistical model of plasma turbulence in the RFP; analytic and numerical calculations of resistive ballooning modes in toroidal geometry; work on coherent m = 0 excitations observed in the ZT-40M device; finite Larmor radius effects on the tearing mode; destabilization of MHD modes by kinetic effects; and, possible plasma heating by means of magnetoacoustic oscillations.

62409 **(LA-UR—82-2466) High-density-plasma diagnostics in magnetic-confinement fusion.** Jahoda, F.C. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 51p. (CONF-820944—1). NTIS, PC A04/MF A01. Order Number DE82021897.

From Workshop on diagnostics for fusion reactor conditions; Varenna, Italy (6 Sep 1982).

The lectures will begin by defining high density in the context of magnetic confinement fusion research and listing some alternative reactor concepts, ranging from n/sub e/ ~ 2 x 10^{14} cm^{-3} to several orders of magnitude greater, that offer potential advantages over the main-line, n/sub e/ ~ 1 x 10^{14} cm^{-3}, Tokamak reactor designs. The high density scalings of several major diagnostic techniques, some favorable and some disadvantageous, will be discussed. Special emphasis will be given to interferometric methods, both electronic and photographic, for which integral n/sub e/dl measurements and associated techniques are accessible with low wavelength lasers. Reactor relevant experience from higher density, smaller dimension devices exists. High density implies high β, which implies economies of scale. The specialized features of high β diagnostics will be discussed.

62410 **(LA-UR—82-2529) Two-dimensional cross-section and SED uncertainty analysis for the Fusion Engineering Device (FED).** Embrechts, M.J.; Urban, W.T.; Dudziak, D.J. (Los Alamos National Lab., NM (USA); Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). 1982. Contract W-7405-ENG-36. 5p. (CONF-820942—3). NTIS, PC A02/MF A01. Order Number DE82022021.

From Nuclear data for science and technology international conference; Antwerp, Belgium (6 Sep 1982).

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The theory of two-dimensional cross-section and secondary-energy-distribution (SED) sensitivity was implemented by developing a two-dimensional sensitivity and uncertainty analysis code, SENSIT-2D. Analyses of the Fusion Engineering Design (FED) conceptual inboard shield indicate that, although the calculated uncertainties in the 2-D model are of the same order of magnitude as those resulting from the 1-D model, there might be severe differences. The more complex the geometry, the more compulsory a 2-D analysis becomes. Specific results show that the uncertainty for the integral heating of the toroidal field (TF) coil for the FED is 114.6%. The main contributors to the cross-section uncertainty are chromium and iron. Contributions to the total uncertainty were smaller for nickel, copper, hydrogen and carbon. All analyses were performed with the Los Alamos 42-group cross-section library generated from ENDF/B-V data, and the COVFILS covariance matrix library. The large uncertainties due to chromium result mainly from large convariances for the chromium total and elastic scattering cross sections.

62411 **(LA-UR—82-2543) Experimental studies of field-reversed-configuration (FRC) confinement in FRX-C.** Siemon, R.E.; Armstrong, W.T.; Bartsch, R.R. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 13p. (CONF-820930—14). NTIS, PC A02/MF A01. Order Number DE82022014.

From 9. international conference on plasma physics and controlled nulcear fusion research; Baltimore, MD, USA (1 Sep 1982).

A primary purpose of the large bore (0.5 m dia.) FRX-C field-reversed theta pinch experiment is to study the scaling of plasma particle containment time, tau/sub N/, with major radius, R, of the field-reversed configuration (FRC). At 20 mtorr fill pressure the FRX-C plasma parameters, anti n ~ 4 x 10^{15} c^{-3}, T/sub e/ ~ 100 eV, T/sub i/ ~ 150 eV, are comparable to those obtained in the smaller bore (0.25 m dia.) FRX-B device. Under these conditions, the present measurement of particle confinement time in FRX-C is tau/sub N/ ~ 140 μs, consistent with the scaling tau/sub N/ α R^2, when compared with the earlier FRX-B results. This favorable scaling has been observed with R/rho/sub i/ ~ 30 (rho/sub i/ = ion gyro radius), twice as large as in FRX-B, despite theoretical indications that various MHD instabilities would appear as R/rho/sub i/ was increased. The characteristics of hotter, neutron generating FRC plasma produced at lower fill pressure (5 mtorr), where anti n ~ 2 x 10^{15} cm^{-3}, T/sub e/ ~ 170 eV, T/sub i/ ~ 600 eV, are also presented. In this plasma regime an accurate determination of tau/sub N/ is difficult because of the short stable period observed.

62412 **(LRP—185/81) Measuring T/sub i/ and Z/sub eff/ by Thomson diffusion in a tokamak.** Dupertuis, M.A. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Dec 1981. 93p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE82903479.

Through the use of a Monte Carlo simulation of laser light diffusion through a plasma and by means of electronic analysis of signals, a study is made of the effect of varying several parameters such as noise, the parameter of alpha diffusion, laser strength, duration of impulse, plasma conditions, etc, on the precision of the ΔT/sub i//T/sub i/. An examination is subsequently made of the conditions necessary for measuring Z/sub eff/ by Thomson diffusion as well as the influence of various parameters. A discussion is offered of the practical possibilities of measuring T/sub i/ and Z/sub eff/ in JET and TCA. 20 references, 57 figures, 15 tables.

62413 **(N—82-16877) EBT transport and ambipolar potential formation with rapid loss of high energy impurity ions.** Jaeger, E.F.; Richards, R.K.; Hedrick, C.L. (Oak Ridge National Lab., TN (USA)). Sep 1981. 183-200p. (CONF-810511—). NTIS, PC A20/MF A01.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Density profiles for neutral impurity atoms and impurity ions of a single charge state are calculated as functions of radius in a 1 1/2 D transport calculation for the ELMO bumpy torus (EBT) toroidal plasma. Ad hoc energies and transport rates are assumed for the impurity ions consistent with spectroscopic measurement. Ambipolar transport rates are rederived to include impurity transport in the flux of positive particles, and the electric field is computed self-consistently. Steady state solutions show potential well depths on the order of the impurity ion temperature divided by its charge. Also, due to the large gyroradius of the impurity ions, viscosity limits shear in the poloidal drift velocity. Thus, potential profiles tend to be more parabolic, and the plasma rotates more nearly as a rigid body than would be expected from simple neoclassical theory with no impurities present.

62414 **(N—82-16877) Effect on ambipolar potential of ion cyclotron heating.** Snoji, T.; Tsuboi, F. (Nagoya Univ. (Japan)). Sep 1981. 423-439p. (CONF-810511—). NTIS, PC A20/MF A01.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Variation of ambipolar potential accompanied with ion cyclotron heating was studied. The ion cyclotron heating was carried out in Nagoya bumpy torus by using a half turn antenna which is installed near the mirror throat. The frequency of the RF oscillator is chosen to excite a slow wave mode to heat ions. In typical T mode operation, an increase in ambipolar potential and forming a positive potential hill is observed by using heavy ion beam probe and Langmuir probe. Change in potential is found to be affected by error field and has its maximum value when the field correction current is adjusted so as to minimize the toroidal current.

62415 **(ORNL/TM—8193) Computational methods in tokamak transport.** Houlberg, W.A.; Attenberger, S.E.; Lao, L.L. (Oak Ridge National Lab., TN (USA)). Jun 1982. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01. Order Number DE82016616.

A variety of numerical methods for solving the time-dependent fluid transport equations for tokamak plasmas is presented. Among the problems discussed are techniques for solving the sometimes very stiff parabolic equations for particle and energy flow, treating convection-dominated energy transport that leads to large cell Reynolds numbers, optimizing the flow of a code to reduce the time spent updating the particle and energy source terms, coupling the one-dimensional (1-D) flux-surface-averaged fluid transport equations to solutions of the 2-D Grad-Shafranov equation for the plasma geometry, handling extremely fast transient problems such as internal MHD disruptions and pellet injection, and processing the output to summarize the physics parameters over the potential operating regime for reactors. Emphasis is placed on computational efficiency in both computer time and storage requirements.

62416 **(ORNL/TM—8206) Synchrotron emission from the ring electrons in EBT.** Uckan, T.; Uckan, N.A. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01. Order Number DE82021116.

The energy spectrum of the synchrotron radiation emitted by the relativistic ring electrons in ELMP bumpy Torus (EBT) has been calculated for various classes of isotropic and anisotropic ring electron distribution functions. Calculations have been carried out for present (EBT-I/S) and planned (EBT-P) experiments. The ring temperatures in EBT-I and EBT-S are ~ 200 and ~ 500 keV, respectively. The projected ring temperature in EBT-P is ~ 1000 to 1500 keV. The calculations indicate that the radiation is predominantly in higher harmonics ($l \geq \gamma^3/2$) and the radiation spectrum monotonically decreases and becomes almost flat at high frequencies, as observed in the experiments. With increasing temperature and anisotropy, the total emission increases, the slope of the spectrum decreases, and the peak of the spectrum moves to higher frequency. Correlations of calculated intensity variations with temperature, density, beta, anisotropy, etc., are given that can be used as a useful tool for comparison of theory and experiment, as well as in the determination of ring properties and scaling of the radiation with ring parameters.

62417 **(PB—82-188566) Neutral beam diagnostics: application to REB-plasma interaction experiment.** Bhattacharjee, P.K. (Physical Research Lab., Ahmedabad (India)). Oct 1980. 49p. NTIS, PC A03/MF A01.

The final goal of plasma physics research today is to achieve controlled thermonuclear fusion for generation of power. One of the major problems for the achievement of this goal is to heat the plasma to a high temperature. Among other various techniques applied, the heating of plasma by relativistic electron beam is a significant one. Hence this generation of the experiments in REB - plasma interaction aim to understand the physics of interaction mechanism and transfer of energy from beam to plasma. Neutral beam diagnostics to measure density and ion temperature of the plasma are discussed. This discussion is divided into three parts: (1) Attenuation of monoenergetic neutral beam passing through the plasma is used to measure the density of the plasma; (2) Charge-exchanged high energy neutrals are energy analysed and their intensities measured to get the ion temperature of the plasma; (3) a multi energy neutral beam attenuation is measured to evaluate the ion temperature profiles of the plasma with better accuracy than that of charge exchange measurements. Some of the important design criteria are discussed, and some preliminary results are presented.

62418 **(PPPL—1930) Theory of mode conversion and wave damping near the ion-cyclotron frequency.** Colestock, P.L.; Kashuba, R.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1982. Contract AC02-76CH03073. 58p. NTIS, PC A04/MF A01. Order Number DE82022231.

Using a variational technique, a set of coupled model equations for the mode-conversion process near the ion-cyclotron frequency is derived. The system is truncated to first order in Larmor radius but includes the effects of explicit gradients and a poloidal field. From the equations a conservation rule is extracted which ensures conservation of total energy and provides an explicit expression for the wave damping in differential form. The equations are integrated numerically for the standard cases of fast waves incident from either the low- or high-field sides of the mode-conversion layer. The scaling of the damping processes is discussed and implications for current rf-heating experiments on the Princeton Large Torus are drawn.

62419 **(Rijnhuizen—81-138) Plasma confinement in a screw pinch with elongated cross-section.** Heesch, E.J.M. (FOM-Instituut voor Plasmafysica, Jutphaas (Netherlands); Rijksuniversiteit Utrecht (Netherlands)). Nov 1981. 68p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82702699.

Thesis.

In the screw-pinch device SP IV a plasma is produced inside a non-circular quartz vacuum vessel which is enclosed by a conducting wall. The experiments performed in this device show that force-free currents surrounding the plasma column permit compression towards a highly elongated equilibrium state that does not exhibit fatal instabilities. It was found that an axisymmetric vertical instability is excited during the formation of the plasma. Since this 'hourglass' instability does not fully develop, it does not terminate the confinement. Apart from the very useful diamagnetic loop, also a vertical and a horizontal magnetic probe, a He-Ne interferometer, a set of pick-up coils, and a streak camera are used for diagnosing the plasma behaviour. Analytic equilibrium calculations support the findings that force-free currents largely increase the attainable compression ratios of an elongated, magnetically closed, geometry.

62420 **(SAI—254-82-244-LJ) Mirror stability of a hot-electron ring plasma.** Tsang, K.T. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Aug 1982. Contract AC03-76ET53057. 9p. (PRI—50). NTIS, PC A02/MF A01. Order Number DE82022155.

The free energy associated with the anisotropy in the velocity space of a microwave heated hot electron distribution can drive the mirror mode unstable. The real frequency of this instability is of the same order as the diamagnetic drift of the hot electron.

62421 **(UCID—19422) Plasma-parameter measurements using neutral-particle-beam attenuation.** Foote, J.H.; Molvik, A.W.; Turner, W.C. (Lawrence Livermore National Lab., CA (USA)). 7 Jul 1982. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01. Order Number DE82021120.

Intense and energetic neutral-particle-beam injection used for fueling or heating magnetically confined, controlled-fusion experimental plasmas can also provide diagnostic measurements of the plasmas. The attenuation of an atomic beam (mainly from charge-exchange and ionization interactions) when passing through a plasma gives the plasma line density. Orthogonal arrays of highly collimated detectors of the secondary-electron-emission type have been used in magnetic-mirror experiments to measure neutral-beam attenuation along chords through the plasma volume at different radial and axial positions. The radial array is used to infer the radial plasma-density profile; the axial array, to infer the axial plasma-density profile and the ion angular distribution at the plasma midplane.

62422 **(UCRL—87675) Diagnostics in the hostile environments of a prototype fusion reactor.** Osher, J.E. (Lawrence Livermore National Lab., CA (USA)). 24 Aug 1982. Contract W-7405-ENG-48. 20p. (CONF-820944—2). NTIS, PC A02/MF A01. Order Number DE82021117.

From Workshop on diagnostics for fusion reactor conditions; Varenna, Italy (6 Sep 1982).

Portions of document are illegible.

Various facets of a thermonuclear type plasma that will likely require special considerations or hardening of applied diagnostic instrumentation are reviewed. The discussion will include both on-line diagnostic instrumentation requirements for satisfactory operation and considerations to reduce integrated radiation damage sufficiently for a reasonable diagnostic lifetime. Several new diagnostics aimed specifically at measurements of the plasma characteristics most appropriate to a thermonculear reactor type plasma are discussed. This will include instrumentation needed to make quantitative energy flow measurements during long term operation with the expected high input power sources, and locally very high wall power loadings. The second part of this lecture will broaden diagnostics to include materials damage measurements needed for engineering design studies. This will include needed diagnostic instrumentation to assess first wall damage, sputtering erosion at walls (and high power beam dumps), and radiation damage to components such as insulators.

62423 **(UCRL—87948) TMX tandem-mirror experiments and thermal-barrier theoretical studies.** Simonen, T.C.; Baldwin, D.E.; Allen, S.L. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Livermore, CA (USA); Rensselaer Polytechnic Inst., Troy, NY (USA); Johns Hopkins Univ., Baltimore, MD (USA); Wisconsin Univ., Madison (USA); California Univ., Berkeley (USA)). 29 Jul 1982. Contract W-7405-ENG-48. 19p. (CONF-820930—10). NTIS, PC A02/MF A01. Order Number DE82020352.

From 9. international conference on plasma physics and controlled nulcear fusion research; Baltimore, MD, USA (1 Sep 1982).

This paper describes recent analysis of energy confinement in the Tandem Mirror Experiment (TMX). TMX data also indicates that warm plasma limits the amplitude of the anisotropy driven Alfven ion cyclotron (AIC) mode. Theoretical calculations show strong AIC stabilization with off-normal beam injection as planned in TMX-U and MFTF-B. This paper reports results of theoretical analysis of hot electrons in thermal barriers including electron heating calculations by Monte Carlo and Fokker-Planck codes and analysis of hot electron MHD and microinstability. Initial results from the TMX-U experiment are presented which show the presence of sloshing ions.

62424 **(UCRL—87948-Rev.1) TMX tandem-mirror experiments and thermal-barrier theoretical studies.** Simonen, T.C.; Baldwin, D.E.; Allen, S.L. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Livermore, CA (USA); Rensselaer Polytechnic Inst., Troy, NY (USA); Johns Hopkins Univ., Baltimore, MD (USA); Wisconsin Univ., Madison (USA); California Univ., Berkeley (USA)). 29 Jul 1982. Contract W-7405-ENG-48. 18p. (CONF-820930—10-Rev.1). NTIS, PC A02/MF A01. Order Number DE82020850.

From 9. international conference on plasma physics and controlled nulcear fusion research; Baltimore, MD, USA (1 Sep 1982).

Portions of document are illegible.

This paper describes recent analysis of energy confinement in the Tandem Mirror Experiment (TMX). TMX data also indicates that warm plasma limits the amplitude of the anisotropy driven Alfven ion cyclotron (AIC) mode. Theoretical calculations show strong AIC stabilization with off-normal beam injection as planned in TMX-U and MFTF-B. This paper reports results of theoretical analysis of hot electrons in thermal barriers including electron heating calculations by Monte Carlo and Fokker-Planck codes and analysis of hot electron MHD and microinstability. Initial results from the TMX-U experiment are presented which show the presence of sloshing ions.

62425 **Two-dimensional interferometric imaging of moving plasma disturbances in the ZT-40M reversed-field pinch, using time-delayed correlation techniques.** Jacobson, A.R.; Forman, P.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **41**: No. 6, 520-521(15 Sep 1982). Contract W-7405-ENG-36.

An eight-chord interferometer array, together with a single-chord interferometer separated toroidally by 90°, shows propagating global plasma density disturbances in the final 1 ms prior to discharge termination in ZT-40M. A time-delayed correlation technique applied to the nine-chord data allows reconstruction of the shape of the propagating disturbance and discriminates against competing random density fluctuations.

62426 **Measurement of the tandem mirror experiment x-ray spectrum.** Burginyon, G.; Snyder, H.D.; Stoering, J.P.; Toor, A.; Poulsen, P.; Anderson, C. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **53**: No. 9, 6085-6089(Sep 1982). Contract W-7405-ENG-48.

We measured x-ray spectrum at the Tandem Mirror Experiment (TMX) facility as a function of time using a new x-ray spectrometer with medium energy resolution that measures as well as identifies x rays in intense and varied particle and radiation backgrounds. The x-ray spectrum was deconvoluted from single-channel energy responses recorded one at a time for each shot. The data for each channel were normalized to the total x-ray energy, which was measured separately for each shot. After a few milliseconds during which conditions within the plasma pulse stabilized, the spectrum consisted of a broad peak with a typical median energy of 0.66 +- 0.04 keV, which can be interpreted as predominantly line emission. Resolution studies indicate that neonlike titanium may be a better interpretation than heliumlike oxygen; however, no quantitative model has been compared.

62427 **Dependence of striation spacing in linear laser sparks on gas pressure and luminosity.** Schmieder, R.W. (Sandia National Laboratories, Livermore, California 94550). *Journal of Applied Physics;* **53**: No. 9, 6096-6100(Sep 1982).

The variation of spacing between separate plasma regions in linear sparks produced by a laser spike train on initial gas pressure and the correlation between the spacing and plasma luminosity have been investigated for several gases in the range 20—760 Torr. Fourier analysis of the quasiperiodic images reveals details of these sparks not readily seen in the photographic and diode-array images.

62428 **Diode array images of linear laser sparks.** Schmieder, R.W. (Sandia National Laboratories, Livermore, California 94550). *Journal of Applied Physics;* **53**: No. 9, 6101-6105(Sep 1982).

The dependence of time-integrated diode array images of linear striated filamentary laser sparks on gas pressure and laser energy is described. For sparks in air, it was found that the pressure regime 100—300 Torr produces images of minimum diameter (about 150 μm) and maximum sharpness. Diode array images exhibit longitudinal and transverse luminosity profiles which differ from photographic images due to different spectral sensitivities. These data are of value in using the linear laser spark as an imaging probe of inhomogeneous gases such as turbulent reacting flows and diffusion flames.

62429 **CO_2 laser interferometer for temporally and spatially resolved electron density measurements.** Brannon, P.J.; Gerber, R.A.; Gerardo, J.B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Review of Scientific Instruments;* **53**: No. 9, 1403-1406(Sep 1982).

A 10.6-μm Mach—Zehnder interferometer has been constructed to make temporally and spatially resolved measurements of electron densities in plasmas. The device uses a pyroelectric vidicon camera and video memory to record and display the two-dimensional fringe pattern and a Pockels cell to limit the pulse width of the 10.6-μm radiation. A temporal resolution of 14 ns has been demonstrated. The relative sensitivity of the device for electron density measurements is 2 x 10^{15} cm^{-2} (the line integral of the line-of-sight length and electron density), which corresponds to 0.1 fringe shift.

62430 **Multichannel light detector system for visible continuum measurements on Alcator C.** Foord, M.E.; Marmar, E.S.; Terry, J.L. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Review of Scientific Instruments;* **53**: No. 9, 1407-1409(Sep 1982).

A spatially resolving visible light detector system has been constructed and used to measure continuum radiation in the wavelength region near 5360 A on the Alcator C tokamak. The instrument measures the line integral brightnesses from 20 chords through the plasma. For high-electron temperature regimes and relatively line-free wavelength regions, Z/sub eff/(r, t) is inferred from Abel inverted brightness profiles. During the steady-state portion of the discharge, Z/sub eff/(r) is usually found to be constant within 10% out to r/a = 0.75.

62431 **Bolometer for use in a noisy electromagnetic environment.** Miller, G.; Ingraham, J.C.; Schrank, L.S. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **53**: No. 9, 1410-1413(Sep 1982).

A bolometer system for measuring energy flux in a noisy electromagnetic environment is described. The system consists of a platinum foil grid, heated by energy flux from a fusion plasma experiment, whose resistance controls the frequency of a 5-MHz oscillator. The information about heating of the foil is thus shifted to a high-frequency band, and noise pickup (which is mainly at lower frequencies) is reduced.

62432 **Spot spectroscopy: Local spectroscopic measurements within laser-produced plasmas.** Herbst, M.J.; Burkhalter, P.G.; Grun, J.; Whitlock, R.R.; Fink, M. (Naval Research Laboratory, Washington, D.C. 20375). *Review of Scientific Instruments;* **53**: No. 9, 1418-1422(Sep 1982).

Use of a locally embedded tracer in laser-irradiated solid targets yields a localized source of diagnostic x-ray line radiation in the blowoff plasma. This technique potentially eliminates problems of chord integration over regions of varying density and temperature in an inhomogeneous plasma, and reduces complications due to plasma opacity effects in the interpretation of spectra. Spectra obtained in an experimental test of this new technique are of a quality superior to those obtained from standard laser-produced plasmas, and should provide the best tests to date of spectroscopic models for these plasma conditions.

62433 **Hydrodynamic instabilities in an imploding cylindrical plasma shell.** Han, S.J.; Suydam, B.R. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **26**: No. 2, 926-939(Aug 1982).

Hydrodynamic instabilities of a cylindrical plasma shell which is imploded by the pressure of an external massless fluid are considered. The plasma shell is assumed to be a compressible, isentropic fluid which is describable as an ideal gas (p = arho/sup γ/, γnot =1). The unperturbed plasma shell is assumed to undergo a self-similar motion. This assumption together with mass conservation determines the time-dependent pressure profile of the plasma shell. Linear stability analyses for this prescribed self-similar motion are carried out analytically. Stability criteria are obtained in terms of the ratio of specific heats γ and an azimuthal mode number of perturbations. It is shown that the imploding plasma shell is unstable to compressible perturbations when $\gamma<2$. In the case of incompressible perturbations, similar calculations show that the Rayleigh-Taylor instability occurs at the outer surface and, in addition, the unstable mode develops at the inner surface. A plausible mechanism for the development of the unstable mode at the inner surface is given.

62434 **Stabilization of the internal kink mode in finite beta toroidal plasmas.** Crew, G.B.; Ramos, J.J. (Massachusetts INstitute of Technology, Cambridge, Massachusetts 02139). *Physical Review* [*Section*] *A: General Physics;* **26**: No. 2, 1149-1152(Aug 1982).

The stability of the interanl kink mode in a finite beta model confinement configuration is investigated using theideal magnetohydrodynamic energy principle. We demonstrate analytically that the mode becomes stable at sufficiently high beta, independent of its toroidal wave number. A numerical estimate of the "second" marginally stable point is given.

62435 **Identification of magnetic dipole lines above 2000 A in several highly ionized Mo and Zr ions on the PLT tokamak.** Suckewer, S.; Hinnov, E.; Cohen, S.; Finkenthal, M.; Sato, K. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Physical Review* [*Section*] *A: General Physics;* **26**: No. 2, 1161-1163(Aug 1982).

A number of spectrum lines arising from magnetic dipole transitions in the n = 3 shell ground configurations of molybdenum and zirconium ions have been identified. These lines are particularly suitable for spectroscopic diagnostics in tokamak-type plasmas in the 500—1500-eV temperature range.

62436 **Plasma diagnostics.** Benenson, D.M.; Kwok, H.S. (State Univ. of New York, Buffalo (USA). Dept. of Electrical and Computer Engineering). *Pure and Applied Chemistry;* **54**: No. 6, 1157-1180(Jun 1982).

An overview is given of four diagnostic methods applicable to the determination of the local temperature (and particle density) and velocity fields in plasmas: spectroscopy, laser-induced fluorescence, interferometry, and laser velocimetry.

62437 **Consequences of toroidal effects in lower hybrid heating of tokamaks.** Bernabei, S.; Ignat, D.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **22**: No. 6, 735-740(Jun 1982).

The lower hybrid slow wave tends to follow magnetic field lines. Therefore, a generalization of Snell's Law modifies the wavelength along the magnetic field as the wave moves inward from an exciter through regions of varying magnetic field strength. Predicting the consequences requires a numerical treatment, which has been developed in recent years by several authors. This paper searches for some general statements on the problem by analysing many particular cases, without allowing for scattering, multiple traverses of the plasma radius and non-linear effects. We find that the range of parameters suitable for ion heating varies from that predicted by simple estimates and is dependent on launch position; and that electron heating including current drive is best pursued with unidirectional launching from a coupler at the top (or bottom) of the torus if the wave frequency is close to the linear mode conversion condition.

62438 **Penetration of molecular impurities at the edge of tokamaks.** Langer, W.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **22**: No. 6, 751-761(Jun 1982).

The transport of molecules at the plasma edge in tokamaks is discussed in order to compare how light impurities enter the plasma if they are released either in atomic or molecular form. Differences in their transport arise because of the dissimilarities between atomic and molecular reactions with the bulk of the plasma. It is found that re-cycling to the walls is more efficient for the light impurities released in molecular form, but, also, that a substantial fraction of those atoms which originate from molecules may penetrate further into the plasma.

62439 **Magneto-acoustic cyclotron instability due to neutral beam injection.** Bhadra, D.K.; Chiu, S.C.; Harvey, R.W. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 6, 763-772(Jun 1982).

Instabilities driven by energetic ion beams injected for ion heating in magnetically confined plasmas have attracted considerable interest in connection with both plasma heating and containment. In this paper, the range of fast-ion distribution functions resulting from near-perpendicular neutral injection into Doublet-3 is determined using a numerical Fokker-Planck code and a guiding-centre Monte Carlo code. Guided by these results, we consider the possibility of exciting magnetosonic cyclotron instability due to anisotropic non-Maxwellian energetic ions streaming at an arbitrary angle with respect to the magnetic field, and show the possibility of unstable waves with fairly large growth rates. The threshold condition and the range of physical parameters where such a growth is possible are obtained. We also consider the contribution of magnetically trapped energetic beam particles to the growth of such magneto-acoustic cyclotron waves.

62440 **High-n collisionless ballooning modes in axisymmetric toroidal plasmas.** Cheng, C.Z. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **22**: No. 6, 773-785(Jun 1982).

A collisionless kinetic ballooning-mode equation, which includes the full ion finite-Larmor-radius (FLR), the magnetic-drift, and the trapped-electron effects, is derived and investigated for a large-aspect-ratio, circular-flux-surface equilibrium in the frequency regime, ωsub(bi), ωsub(ti)$<\omega<\omega$sub(be), ωsub(te). The finite-Larmor-radius effects can reduce the growth rate, but do not stabilize the ballooning modes due to the destabilizing influence of the ion-magnetic-drift resonances. It is, in general, incorrect to simulate the FLR effects by employing the often used FLR-modified MHD model for (ksub(theta)rhosub(i))^2 approximately >0.1 and epsilonsub(n) approximately >0.1, where ksub(theta)rhosub(i) is the ion FLR parameter and epsilonsub(n)=Lsub(n)/R measures the magnetic-drift frequency. The trapped electrons have a stabilizing effect due to the reduction of the destabilizing circulating-electron parallel-current perturbation. For a typical tokamak aspect ratio, the critical β can be improved by 40%.

62441 **Kinetic theory of electron cyclotron current drive in a toroidal device.** Chan, V.S.; Chiu, S.C.; Hsu, J.Y.; Wong, S.K. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 6, 787-795(Jun 1982).

The toroidal current induced by a travelling electron cyclotron wave in a tokamak is estimated, taking into account toroidal-geometry effects. It is found that the anisotropic-resistivity effect is opposed by neoclassical trapped-particle effects away from the centre of the plasma. This leads to a reduction of current generation efficiency toward the outside.

62442 **Magnetic analysis of non-circular cross-section tokamaks.** Luxon, J.L.; Brown, B.B. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 6, 813-821(Jun 1982).

Techniques are presented for determining the MHD equilibrium configuration for circular and non-circular plasmas from measurements of the magnetic field and flux made outside the discharge. Least-squares minimization techniques are introduced to provide an objective means for comparing the experimental data with the corresponding calculated equilibrium and for error estimation. Free-boundary equilibria using a simple model for the plasma-current profile with three free parameters - total current, poloidal beta, and a single parameter describing the peakedness of the current profile - are found to be statistically adequate and sufficient to describe the magnetic configuration of the discharge. In plasmas with significant non-circularity, the Shafranov dimensionless inductance, lsub(i), can be determined independent of βsub(p). Examples of the application of the technique to discharges in the Doublet-III tokamak are presented.

62443 **Quasi-linear calculation of ion tails and neutron rates in a D-T plasma due to lower hybrid waves.** Schuss, J.J. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). *Nuclear Fusion;* **22**: No. 6, 831-835(Jun 1982).

Quasi-linear theory is used to calculate the distribution function and neutron rate of a D-T plasma being heated by a lower hybrid wave. It is shown that Q-values approaching 1 are possible for sufficiently high bulk temperatures and for small deuterium concentrations.

62444 **Alpha-particle diamagnetic drift effects on tokamak ballooning stability.** Cooper, W.A. (Oak Ridge National Lab., TN (USA)). *Nuclear Fusion;* **22**: No. 6, 835-840(Jun 1982).

The diamagnetic drift frequency impact on the ballooning stability of INTOR-like tokamaks that contain a Maxwellian energetic ion species is investigated. The energetic ion diamagnetic drift frequency contribution enhances the critical beta (βsub(c)) imposed by ballooning modes with toroidal mode numbers n $>=7$ by a factor of 1.2 to 1.3 above the corresponding limits obtained when the plasma consists of only thermal species.

62445 **Spectroscopic diagnostic for ablative compression experiments.** Lee, R.W.; Matthews, D.L.; Lane, S.M.; Campbell, E.M.; Koppel, L.; Scofield, J.; Auerbach, J.; Lim, T. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Journal of Physics B: Atomic and Molecular Physics;* **15**: No. 9, L317-L321(14 May 1982).

A spectroscopic diagnostic which will be useful for laser-driven thick-shelled ablative compression targets is demonstrated. The diagnostic which uses spectral line emission from lithium-like bromine provides information from several allowed lines in a small spectral range and can be used to estimate ground state number density as well as electron density in the compressed core.

62446 **Collisional limits of resonant and neoclassical transport in tandem mirrors.** Cohen, R.H.; Nevins, W.M. (California Univ., Livermore (USA). Lawrence Livermore National Lab.); Stupakov, G.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). *Nuclear Fusion;* **22**: No. 5, 611-616(May 1982).

Neoclassical and resonant transport in tandem mirrors in considered in the limit where the collision frequency nusub(c) exceeds the bounce frequency nusub(b) for solenoid ions. Approximate expressions for the diffusion coefficient are obtained analytically and verified by using a random walk code. These expression scale as nusub(c), (nusub(c)/nusub(d))sup(1/2)nusub(b), or nusub(b), depending on the value of the azimuthal drift frequency nusub(d). The connection to regimes of lower collisionality is described. In particular, for neoclassical transport (nusub(d)/nusub(b)$<<$1) at moderate collisionality, a mechanism previously described but not generally known leads to a term in the diffusion coefficient which scales as nusub(c) and allows smooth matching to the high-collisionality regime.

62447 **Ideal magnetohydrodynamic stability of the spheromak configuration.** Jardin, S.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **22**: No. 5, 629-642(May 1982).

Results are presented of a parametric study of the ideal magnetohydrodynamic stability properties of the spheromak, or compact torus, configuration. In the absence of a nearby conducting wall, the spheromak is always unstable to at least one current-driven mode. With conducting wall at the surface, the spheromak can be unstable to current-driven modes if the current is too peaked, i.e. $q_0(R/a)<2/3$, or if the shear is too low at the origin. The Mercier criterion sets an upper limit on the pressure gradient everywhere, but configurations that are everywhere Mercier-stable can b unstable to pressure-driven low-n modes. Stable toroidal configurations exist with a spherical wall separated by half a minor radius, and with βsub(theta)=30%.

62448 **Calculations of 3D mirror equilibria using a finite element vector potential representation.** Anderson, D.V.; Breazeal, J.; Sharp, C.B. (National Magnetic Fusion Energy Computer Center, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Computational Physics;* **46**: No. 2, 189-270(May 1982). Contract W-7405-ENG-48.

Several applications of plasma equilibrium models require a suitable continuous representation for the magnetic field. For example, numerical generation of single particle orbits in these fields requires that the continuum representation maintain del. B = 0 or at least keep it very small. Performing the interpolation analysis in terms of the vector potential A guarantees delxB = 0, whereas using the magnetic induction B does not. The code presented here uses A as the primary dependent variable. A finite element representation employing tricubic splines significantly reduces spatial truncation errors compared to conventional finite difference methods. The theoretical equilibrium model allows pressure functions of the form B(B,psi) = P(B)ω(psi). A modified long-thin approximation is derived which includes field line curvature effect; it agrees well with the results obtained from the code. Some results pertinent to the MFTF-B experiment are presented.

62449 **Implicit method for electromagnetic plasma simulation in two dimensions.** Brackbill, J.U.; Forslund, D.W. (Applied Theoretical Physics Division, Low Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* **46**: No. 2, 271-308(May 1982).

A new method for modeling low-frequency plasma phenomena is presented. The method uses an implicit formulation of the Vlasov-Maxwell equations to relax restrictions on the time-step and mesh spacing so that larger values which correspond to the frequencies and wavelengths of interest can be used. As a result, the range of length and time scales accessible to plasma simulation is increased by orders of magnitude. The algorithm, as embodied in a new code VENUS for electromagnetic plasmas in two dimensions is described, its stability and accuracy analyzed through linear and nonlinear analysis, and its properties, including suppression of the finite grid instability, illustrated through its application to the Weibel instability.

62450 **Monte-Carlo model of neutral-particle transport in diverted plasmas.** Heifetz, D.; Post, D.; Petravic, M.; Weisheit, J.; Bateman, G. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Computational Physics;* **46**: No. 2, 309-328(May 1982).

The transport of neutral atoms and molecules in the edge and divertor regions of fusion experiments has been calculated using Monte-Carlo techniques. The deuterium, tritium, and helium atoms are produced by recombination at the walls. The relevant collision processes of charge exchange, ionization, and dissociation

between the neutrals and the flowing plasma electrons and ions are included, along with wall-reflection models. General two-dimensional wall and plasma geometries are treated in a flexible manner so that varied configurations can be easily studied. The algorithm uses a pseudocollision method. Splitting with Russian roulette, suppression of absorption, and efficient scoring techniques are used to reduce the variance. The resulting code is sufficiently fast and compact to be incorporated into iterative treatments of plasma dynamics requiring numerous neutral profiles. The calculation yields the neutral gas densities, pressures, fluxes, ionization rates, momentum-transfer rates, energy-transfer rates, and wall-sputtering rates. Applications have included modeling of proposed INTOR/FED poloidal divertor designs and other experimental devices.

62451 **Tearing-mode stability of a forming spheromak plasma.** Heidbrink, W.W.; Jardin, S.C.; Chance, M.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **22**: No. 4, 459-464(Apr 1982).

The results of numerical calculations of Δ′ for a class of equilibria typical of those encountered during the early formation stage of the S1 Spheromak are presented. The equilibrium plasma is assumed to be cylindrically symmetric and pressureless. It encloses a current-carrying perfect conductor (flux core) and is surrounded by a vacuum with zero longitudinal field. Stability boundaries in the space formed by the equilibrium parameters are mapped. The plasma is tearing-mode-stable provided Bsub(z)/Bsub(theta) at the flux core is below a certain critical value which depends on the equilibrium parameters. For typical equilibria, this critical value is 0.65.

62452 **MHD equilibria of current-carrying plasma in a toroidal-helical configuration.** Yamagishi, T.; Bard, W.D.; Chu, M.S. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 4, 527-538(Apr 1982).

A successive iteration method has been developed to investigate the MHD equilibrium of high-current plasma in an $l>1$ toroidal-helical configuration of large aspect ratio. In this scheme, helical and toroidal effects are treated as perturbations. The order of perturbation determines possible Fourier mode numbers, and the equilibrium configuration can be expressed by a small number of Fourier terms. The differential equations for the Fourier coefficients have been studied and solved numerically up to the toroidal-helical coupling effect for OHTE configurations.

62453 **Scaling of energy confinement time with the minor radius in the FT tokamak.** Sharky, N. (Massachusetts Inst. of Tech., Cambridge (USA)). *Nuclear Fusion;* **22**: No. 4, 568-571(Apr 1982).

The scaling of the electron energy confinement time with the plasma minor radius, derived from FT data only, does not agree with that obtained by comparing the same data with experimental results from othe devices. It is shown that, by taking into account the systematic difference in the measured density profiles for different limiter radii in FT, this apparent disagreement vanishes. The resulting scaling with the minor radius in FT is also consistent with the scalings derived by comparison of a wide variety of Ohmically heated tokamak discharges.

62454 **Tandem mirror hot-electron anchors.** Kesner, J.; Post, R.S.; Smith, D.K. (Massachusetts Inst. of Tech., Cambridge (USA)); Baldwin, D.E. (Lawrence Livermore National Lab., CA (USA)); Lee, Y.C. (Maryland Univ., College Park (USA)). *Nuclear Fusion;* **22**: No. 4, 577-583(Apr 1982).

An ECRH-generated hot-electron plasma is shown to provide an attractive alternative to a neutral-beam-formed plasma for the MHD 'anchor' of a tandem mirror. This mirror cell would provide a finite-Larmor-radius-like stabilization for $m=1$ modes. For a significant MHD fluid-like response, a small ion core beta is seen to be required and stabilization results from the response of the core beta in the hot-electron-depressed magnetic field. At a higher core beta the hot electrons behave in a fluid-like manner. Utilization is most promising in an outboard-anchor tandem mirror arrangement.

62455 **Non-linear coupling to lower-hybrid waves in a tokamak plasma.** Theilhaber, K. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). *Nuclear Fusion;* **22**: No. 3, 363-381(Mar 1982).

The non-linear coupling of lower hybrid waves excited by a waveguide array is examined numerically and analytically in a model of a tokamak plasma. The non-linearity considered is the ponderomotive force and the fields are evolved self-consistently in time to the steady state. Simplified coupling models are derived for the loading of large and small arrays and for different phasings of the waveguides. It is found that the reflection coefficient can be modified considerably by the non-linear effects and that the non-linear modification of the power spectrum is especially large when the array excites two resonance cones. The fields filament and the spectrum is broadened and upshifted. The travelling-wave excitation, which excites a single resonance cone and is considered for current drive, is less affected non-linearly; the fields do not filament and the spectrum remains narrow.

62456 **Plasma channels for intense-light-ion-beam reactors.** Freeman, J.R.; Baker, L.; Cook, D.L. (Sandia National Labs., Albuquerque, NM (USA)). *Nuclear Fusion;* **22**: No. 3, 383-393(Mar 1982).

Numerical calculations are presented which study the use of current-carrying plasma channels in gas-filled (argon) reactor chambers for intense-light-ion-beam inertial fusion. A 1-D MHD model is used to compute the channel behaviour on both channel formation and beam injection time scales. A two-stage drive sequence is proposed to create a low-density channel which would contain sufficient discharge current to confine the injected ion beam. Collisional and Ohmic losses are evaluated for a particular proposed reactor concept. These losses would degrade the beam energy by about 30% for a 4-m-radius reactor filled with 10 torr of argon, an efficiency consistent with those assumed in the reactor study.

62457 **Development of neutral-beam injectors. Report on the third workshop, Gatlinburg, Tennessee, United States of America 19-23 October 1981.** Menon, M.M.; Whealton, J.H. (Oak Ridge National Lab., TN (USA)). *Nuclear Fusion;* **22**: No. 3, 439-443(Mar 1982).

This paper reports on the third workshop on the development of neutral-beam injectors held from 19-23 October 1981 at Gatlinburg, Tennessee, USA. The programme of the workshop was devoted to the development of positive-ion-based neutral injectors, although several techniques for producing negative ion beams were also discussed.

62458 **Self-organization of turbulence. A brief review of self-organization with particular reference to hydrodynamic and magnetohydrodynamic turbulence.** Hasegawa, A. (Bell Labs., Murray Hill, NJ (USA)). *Europhysics News;* **13**: No. 2, 1-3(Feb 1982).

Theoretical treatments of turbulence in fluids and plasmas often assume that the turbulence is isotropic and homogeneous. It is also often considered that turbulence produces uniformly distributed chaos, even when starting with a coherent initial condition. Recently, however, phenomena which do not obey these classic concepts have emerged. For example, in two-dimensional Navier-Stokes turbulence, an organized flow or structure is found to appear even from a chaotic initial condition. The author attempts to review some of the recent developments of a phenomenon called self-organization in the field of hydrodynamics and plasma physics.

62459 **Ideal- and resistive-MHD stability of one-dimensional tokamak equilibria.** Chance, M.S.; Furth, H.P.; Glasser, A.H.; Selberg, H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **22**: No. 2, 187-201(Feb 1982).

The MHD equilibrium and stability of a vertically elongated tokamak configuration are analysed in the one-dimensional limit corresponding to infinite elongation. Stability against all ideal-MHD modes can be obtained for beta values arbitrarily close to unity. In the finite-resistivity stability analysis, axisymmetric ($m=0$) tearing modes, centred on the null trace of the poloidal field, can be stabilized by a loosely fitting conducting shell. The presence of

the toroidal field component, however, introduces the possibility of non-symmetric tearing modes (m not equal to 0), centred away from the null trace. These modes can be stabilized only by a more tightly fitting shell, plus reliance on finite-pressure effects on the small-major-radius side of the plasma profile. Under these conditions, stable configurations with peak beta values approaching unity are readily found.

62460 **Energy principle for stability of general force-free MHD equilibria.** Chu, M.S.; Jensen, T.H.; Lee, J.K. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 2, 213-222(Feb 1982).

An energy principle has been constructed for the determination of stability of general force-free equilibria against ideal- and dissipative-(tearing)-MHD modes. The concept of accessible neighbouring equilibria, with the inclusion of singular currents on mode rational surfaces, is used. The driving source of these instabilities may be either the parallel current density or the parallel current density gradient. This energy prnciple is well suited for numerical implementation. Reduction of this energy principle to some known cases is also presented.

62461 **Ambipolar potential formation and axial confinement in TMX.** Correll, D.L.; Allen, S.L.; Casper, T.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Fusion;* **22**: No. 2, 223-234(Feb 1982).

TMX experimental data on ambipolar potential control and on the accompanying electrostatic confinement are reported. In the radial core of the central cell, measurements of electrostatic potentials of 150V which augment axial ion confinement are in agreement with predictions using the Maxwell-Boltzmann result. Central-cell ion confinement was observed to scale according to electrostatic potential theory up to average enhancement factors of eight times over mirror confinement alone.

62462 **Comments on the paper by L. Chen, M.S. Chance, C.Z. Cheng 'Absolute dissipative drift-wave instabilities in tokamaks' Nucl. Fusion 20 (1980) 901.** Marchand, R.; Guzdar, P.N. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). *Nuclear Fusion;* **22**: No. 2, 289-291(Feb 1982).

62463 **A galerkin guadrature formulation for one-dimensional discrete-ordinates calculations.** Morel, J.E. (Sandia, Albuquerque, NM 87185). *Transactions of the American Nuclear Society;* **39**: 459-460(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

62464 **An integral transform technique for solving the grad-shafranov equilibrium equation.** Miley, G.H.; Olson, R.E. (Univ of Illinois, Urbana, IL 61801). *Transactions of the American Nuclear Society;* **39**: 489-490(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

62465 **A multigroup method for ion slowing down with velocity diffucion.** Galambos, J.; Gilligan, J.; Greeenspan, E.; Miley, G.H.; Stroud, P. (Univ of Illinois, Urbana, IL 61801). *Transactions of the American Nuclear Society;* **39**: 490-491(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

62466 **A one-dimensional kinetic ion model for field reversed mirror dynamics.** Haill, T.A.; Miley, G.H.; Stark, R.A. (Univ of Ill, Urbana, Il 61801). *Transactions of the American Nuclear Society;* **39**: 491-492(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

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REFER ALSO TO CITATION(S) 61756, 61774, 61775, 61782, 61799, 61800, 61822, 61885, 61886, 61887

62467 **(BNL—31600) Fusion-reaction cross section in (high-temperature) μ-catalyzed fusion.** Takahashi, H.; Moats, A. (Brookhaven National Lab., Upton, NY (USA)). Jun 1982. Contract AC02-76CH00016. 5p. (CONF-821103—11). NTIS, PC A02/MF A01. Order Number DE82019450.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

The barrier penetration factor for the fusion reaction of μ-mesic hydrogen atoms with hydrogen nuclei is studied. (MOW)

62468 **(CONF-810831—97) Operational history of stainless steel, TiC, TiB_2, and boron limiters in the ISX-B Tokamak.** Emerson, L.C.; Bush, C.E.; Isler, R.C.; Langley, R.A.; Clausing, R.E.; Saltmarsh, M.J.; Whitley, J.B.; Mullendore, A.W. (Oak Ridge National Lab., TN (USA); Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE82020902.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

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For the past eighteen months a variety of low-z coatings have been tested for service as limiters in both ohmically-heated and beam-heated ISX-B plasmas. To date TiC, TiB_2, and B coatings on a graphite substrate have been examined. The history of these materials in ISX-B is reviewed with particular emphasis and compared with previously used stainless steel limiters on machine performance.

62469 **(DOE/ER/10698—2) Cryogenic polarized-target facility. Progress report, July 1, 1981-June 30, 1982.** Gould, C.R.; Haase, D.G. (North Carolina State Univ., Raleigh (USA)). 1982. Contract AS05-80ER10698. 11p. NTIS, PC A02/MF A01. Order Number DE82021940.

The goal of this three-year research project is to build a cryogenically polarized target facility for measuring total neutron cross sections for polarized neutrons incident on polarized nuclei. The components of the system have been assembled at TUNL during the current contract period. These include the dilution-refrigerator support assembly, the dilution-refrigerator itself, the dewar, the beam line, the shielding cave for the neutron source, and the neutron-detector shield and rolling-cart assembly. The dilution refrigerator is presently undergoing testing at liquid-nitrogen and liquid-helium temperatures. Experiments with aluminum and copper targets are scheduled for the coming contract period.

62470 **(DOE/ER/10767—1) Velocity selector for heavy-ion fusion studies. Final report, September 1, 1980-February 28, 1982.** Enge, H.A. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). 1982. Contract AC02-80ER10767. 17p. NTIS, PC A02/MF A01. Order Number DE82019271.

The velocity selector discussed in this report is designed to collect heavy nuclei recoiling from a fusion reaction. The basic function of the instrument is to separate the beam from these recoiling nuclei at or close to 0°. The instrument can be used in conjunction with gamma-detectors and/or particle detectors close to the target and also in conjunction with gamma-detectors at the point of collection of the recoils. It is possible to include in the system a magnetic dipole such that a mass dispersion is produced. This will make the instrument into a recoil isotope separator. It is also possible to combine the instrument with time-of-flight measurements for mass identification of the recoils.

62471 **(DOE/ET/51013—46) Solve: a non linear least-squares code and its application to the optimal placement of torsatron vertical field coils.** Aspinall, J. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 25 May 1982. Contract AC02-78ET51013. 63p. (PFC/RR—82-16). NTIS, PC A04/MF A01. Order Number DE82015605.

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A computational method was developed which alleviates the need for lengthy parametric scans as part of a design process. The method makes use of a least squares algorithm to find the optimal value of a parameter vector. Optimal is defined in terms of a utility function prescribed by the user. The placement of the vertical field coils of a torsatron is such a non linear problem.

62472 **(DOE/ET/51013—57) Predesign of a new OHT power supply for VERSATOR II.** Ramos, J.S. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1982. Contract AC02-78ET51013. 37p. NTIS, PC A03/MF A01. Order Number DE82022496.

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A basic design of a new OHT power supply for VERSATOR II, is advanced. A requirement on the design is to permit the operation of VERSATOR II in two modes: the double swing, in which a longer plasma pulse should be obtained; and the primary shut-off, when the plasma is not driven anymore by the OHT, but by RF waves (RF current drive mode). The report was organized as follows: In Section I the establishment of a current bias is examined. In Section 2 the commutation phase is analyzed, restricted to the use of a saturable inductor. Section 3 deals with the start-up phase, which break-downs the gas, creating the plasma. Section 4 is devoted to the double swing drive, and Section 5 to the OHT shut-off. In Section 6 a list of major components is written down.

62473 **(DOE/ET/52040—245) Discrete nuclear-elastic-scattering effects in Cat-D and D-^{3}He fusion plasmas.** Galambos, J. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1982. Contract AC02-76ET52040. 34p. (CONF-821103—2; COO—2218-245). NTIS, PC A03/MF A01. Order Number DE82016825.

From American Nuclear Society winter meeting; Washington, DC, USA (14 Nov 1982).

The effects of Nuclear Elastic Scattering (NES) of fusion products are investigated for Cat-D and D-^{3}He plasmas. It is found that accounting for the discrete nature of the large energy transfer associated with NES is necessary to accurately calculate the plasma distribution functions, and effects on overall plasma characteristics such as ignition requirements. For cases where cyclotron losses are important, inclusion of NES can reduce the ignition requirements by 50%.

62474 **(DOE/ET/53051—37) High beta multipoles.** Prager, S.C. (Wisconsin Univ., Madison (USA)). May 1982. Contract AC02-76ET53051. 36p. NTIS, PC A03/MF A01. Order Number DE82015672.

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Multipoles are being employed as devices to study fusion issues and plasma phenomena at high values of beta (plasma pressure/magnetic pressure) in a controlled manner. Due to their large volume, low magnetic field (low synchrotron radiation) region, they are also under consideration as potential steady state advanced fuel (low neutron yield) reactors. Present experiments are investigating neoclassical (bootstrap and Pfirsch-Schlueter) currents and plasma stability at extremely high beta.

62475 **(ECN—112) Fusion technology programme. Semi-annual report July-December 1981.** Elen, J.D. (Netherlands Energy Research Foundation, Petten). Mar 1982. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE82702696.

A conceptual design of a 600 MWe belt-screw-pinch reactor was completed by a joint FOM-KEMA-ECN study team. For the water cooled INTOR blanket concept loss of coolant and loss of flow accidents were analysed. There is some delay permitted to shut down the plasma by control systems. The pressure response and contamination of the plasma chamber might be a problem of serious concern. The codes for evaluation of nuclear data for neutronics calculations were improved on points concerning the pre-equilibrium effects in double differential cross sections at neutron energies from 5 to 20 MeV. Activation and transmutation calculations were performed for the candidate construction materials AISI 316, AMCR, EM12, TZM, Ti6Al4V and V20Ti. The formation of cavities in irradiated Nb, Nb1.2Zr and Nb1.2Zr0.4Mo samples was observed by electron microscopy. Preimplanted helium concentrations ranged from 0 to 1000 at. ppm and subsequent fast neutron irradiations correspond to 1.0 and 3.6 dpa. Their total volume fraction amounted to 0.1% in the alloys compared to 0.3% for pure niobium. Helium was observed to enhance the nucleation of cavities in the alloys for this range of dpa levels. Manufacturing of irradiation capsules for tensile, creep and fatigue specimens of AISI 316 has started. The detailed design of the 8 Tesla superconducting coil for the SULTAN testfacility at Villigen has been finalised. Progress is reported on fabrication of components and testing of the winding and impregnation procedures. Manufacturing of a small niobium-tin toroidal field coil had to be reconsidered for budgetary reasons.

62476 **(EPRI-AP—2521) Evaluation of inertial-confinement fusion-engineering opportunities on existing and planned facilities. Final report.** Sink, D.A. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Aug 1982. 183p. NTIS, PC A09/MF A01. Order Number DE82906453.

The objectives of this study were to identify and rank a group of experiments that would provide the most essential data needed by ICF reactor designers, to involve the ICF and experimental facility communities in this process, and to select 10 high ranking experiments for more detailed examination. Seven ICF reactor designs were identified, including two hybrid concepts; their design teams identified 97 data needs by response to a questionnaire and by direct interview. A wide ranging search identified 61 facilities which could provide the needed data. To define the experiments more completely and to find a consensus within the ICF and experimental facility communities as to the importance of the experiments, a workshop was held in which both communities participated. The workshop produced 78 experiments through 12 panel sessions and ranked them in a plenary session using an accelerated Delphi method.

62477 **(GA-A—16426) Low-activation-materials design study. Annual report for fiscal year 1981, October 1, 1980-September 30, 1981.** (General Atomic Co., San Diego, CA (USA)). Sep 1981. Contract AT03-76ET51011. 123p. NTIS, PC A06/MF A01. Order Number DE83000404.

Substitutions of low activation materials were made in the major components of the STARFIRE design and design studies then performed on the resulting components and systems. This provided an assessment of the effects on the system for each low activation component as well as the overall system effects for an entire low activation fusion reactor. Aluminum and silicon carbide were selected as the primary low activation materials. The components considered are first wall, limiter, blanket, vacuum wall, shield, structure, and superconducting magnets. A blanket module outer shell and its internal coolant tubes used silicon carbide; the remainder of the plant employed primarily aluminum. An assessment of carbon for first wall application in INTOR was completed as part of the US effort and is reported here.

62478 **(HEDL-SA—2674-FP) Thermal properties of lithium ceramics for fusion applications.** Hollenberg, G.W.; Baker, D.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1982. Contract AC06-76FF02170. 19p. (CONF-820547—14). NTIS (US Sales Only). Order Number DE82016157.

From 84. annual meeting of the American Ceramic Society; Cincinnati, OH, USA (2 May 1982).

Specific heat, thermal diffusivity and thermal conductivity were measured on Li_2O, Li_4SiO_4, Li_2ZrO_3 and $LiAlO_2$. Data on these properties were needed for design of an irradiation experiment to be performed on these materials. In general, the specific heat of a ceramic is primarily enrichment-dependent, but the thermal diffusivity and thermal expansion coefficient may be influenced by microstructure. Hence, it will be necessary to duplicate these measurements on the engineering materials finally selected for a particular design.

62479 (HEDL-TME—81-46) FMIT test-end instrumentation development bases. Fuller, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1982. Contract AC06-76FF02170. 74p. NTIS, PC A04/MF A01. Order Number DE82021532.

FMIT test-end measurements proposed for deuteron beam control, target diagnostics, and irradiation sample dosimetry are listed. The test-end refers to the area inside the test cell, but includes measurements inside and outside the cell. Justification, categorization, and limits qualification are presented for each measurement. Methods are purposefully de-emphasized in order to clarify the measurement needs, not techniques. Some discussion of techniques currently under investigation is given in the last section of the report.

62480 (IPF—80-8) Space-resolved measurements of neutrons and ions emitted by a plasma focus. Jaeger, U. (Stuttgart Univ. (TH) (Germany, F.R.)). May 1980. 101p. (In German). NTIS, PC A06/MF A01.

Space-resolved measurements of neutrons and of accelerated charged particles emitted by a plasma focus device are presented. The neutron source was measured with one and two dimensional paraffin collimators. The spatial resolution is 5 mn along the axis and the radius, with a time resolution of 10 ns. In order to make quantitative statements about the neutron yield, neutron scattering, absorption, and nuclear reactions were taken into account. Part of the neutron measurement was carried out together with time and space resolved measurements of the electron density to study possible correlations between n sub e and y sub n.

62481 (IPF—81-1) Relation between neutron production and instabilities in a plasma focus. Rueckle, B. (Stuttgart Univ. (TH) (Germany, F.R.)). Jan 1981. 100p. (German). NTIS, PC A05/MF A01.

The macroscopically recognizable circumstances and requirements for a strong neutron emission from a plasma focus were experimentally studied. It was necessary to simultaneously employ many diagnostic techniques with high space and time resolution. A ten channel N2 laser interferometer was developed for the investigation of plasma density is described. Magnetic probes and scintillator multipliers were also used. Neutron and X-ray emissions are connected with the m o (m azimuthal periodicity) pinch instabilities at the end of the discharge. The relation of neutron production to the m o instability is examined. Detail observations show that neutron production is most probably due to a beam-target mechanism. Due to microinstabilities, the plasma resistance is abnormally high during reexpansion after m o instabilities and concomitant deuteron production is observed. (ESA)

62482 (JUEL—1666) An estimate of convection cooling in the boundary layer of toroidal fusion plasmas. Wolf, G.H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Arbeitsgruppe Radioagronomie). Jul 1980. 18p. (In several languages). NTIS, PC A02/MF A01.

By means of a simple model, the boundary layer plasma temperature T in toroidal fusion plasmas was estimated, supposing that the heating power transmitted to a toroidally confined plasma is eventually carried away by convective plasma flow in the boundary layer. The value of T is critical as regards plasma-wall interaction and heat loading of limiters and divertors. The boundary layer of thickness delta fills the interspace between the outermost closed magnetic surface and the first wall which encloses the plasma column toroidally. The model requires that delta is equal to or larger than (10 exp 15)/n cm, n being the average boundary plasma density. The model connects the total heating power with average values of the plasma parameters T and n in the boundary layer and of the angle epsilon which gives the direction of the plasma flow towards the wall. The values of epsilon and delta can be controlled by the field configuration of the magnetic limiter. This results in an estimate of T in front of the first wall (for epsilon xn 10 exp 12 cm exp (-3) and using the parameters of the Tokamaks Textor and Intot, T is on the order of 10 eV or lower). (ESA)

62483 (LA—9382-MS) Tritium monitor for fusion reactors. Jalbert, R.A. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01. Order Number DE82021263.

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This report describes the design, operation, and performance of a flow-through ion-chamber instrument designed to measure tritium concentrations in air containing ^{13}N, ^{16}N, and ^{41}Ar produced by neutrons generated by D-T fusion devices. The instrument employs a chamber assembly consisting of two coaxial ionization chambers. The inner chamber is the flow-through measuring chamber and the outer chamber is used for current subtraction. A thin wall common to both chambers is opaque to the tritium betas. Currents produced in the two chambers by higher energy radiation are automatically subtracted, leaving only the current due to tritium.

62484 (LA—9453-MS) Rederivation of the alpha effect in terms of the magnetic fluctuation spectrum. Keinigs, R.K.; Gerwin, R.A. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 18p. NTIS, PC A02/MF A01. Order Number DE82021264.

We demonstrate that the alpha effect can be expressed in terms of the integrated current helicity spectrum of the turbulence. This is a much more convenient form than that obtained using a kinematic velocity field description.

62485 (LA-UR—82-2391) Role of diagnostic testing in identifying and resolving dimensional-stability problems in electroplated laser mirrors. Cutler, R.L.; Hogan, B. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 6p. (CONF-820822—10). NTIS, PC A02/MF A01. Order Number DE82021882.

From 26. technical symposium and exhibition of the International Society for Optical Engineering; San Diego, CA, USA (21 Aug 1982).

The metal mirrors which are the subject of this discussion are to be used in the Antares inertial fusion laser system. Antares is a high-power (40 TW), high-energy (35 to 40 kJ), pulsed CO_2 laser system for the investigation of inertial confinement fusion. The system contains more than four hundred small and large diamond-turned and conventionally polished mirrors. The largest mirrors are trapezoidal in shape with the longest dimension being 16 to 18 inches. The substrates are type 2124 aluminum for most large mirrors, and aluminum bronze, oxygen-free copper or a copper-zirconium alloy for most of the smaller mirrors. The optical surface is electro-deposited copper 20 to 40 mils thick. After nondestructive testing and rough machining, the electroplated surface is single-point diamond machined or conventionally polished.

62486 (LA-UR—82-2531) Performance of the ZT-40M reversed-field pinch with an Inconel liner. Baker, D.A.; Bausman, M.D.; Buchenauer, C.J. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 14p. (CONF-820930—12). NTIS, PC A02/MF A01. Order Number DE82022020.

From 9. international conference on plasma physics and controlled nulcear fusion research; Baltimore, MD, USA (1 Sep 1982).

Modifications made to ZT-40 have substantially improved plasma parameters: pinch resistance has decreased by more than an order of magnitude, T/sub e/ has exceeded 300 eV, and with power crowbar operation $>$ 20 ms steady-state discharges have been obtained. With a β of $\sim$ 0.1, and the assumptions of modified Bessel function magnetic-field profiles and classical ohmic heating the energy confinement time, $\sim$ 0.2 ms, is close to that expected for the measured temperatures and discharge currents. A relaxation process (dynamo) sustains RFP profiles extending discharge lifetimes beyond the limit predicted by classical resistive diffusion. If the process continues to operate, a steady-state RFP is possible. Extension of the toroidal current risetime to the experiment's design limit (1.5 ms) indicates that RFPs can be formed at still longer risetimes with reasonable voltsecond and energy inputs facilitating the design of future experiments. These results represent a significant advance for the RFP concept toward a viable ohmic-heated magnetic-fusion system.

62487 (NP—2903587) Max Planck Plasma Physics Institute, Garching/Munich. Annual report,1980. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). 1980. 188p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE82903587.

The report contains eight sections describing results and activities of the Institute in the fields of experimental plasma physics (tokamak research, production and acceleration of deuterium pellets for replenishing plasma machines, plasma diagnostics, stellarators, plasma heating), theory (plasma instabilities, torroidal plasma equilibrium), surface physics (ion and metal-surface interaction, plasma marginal density), information retrieval systems and technological studies (computer modelling of fusion-reactor systems, high-frequency experimentation, injection system design). 258 references.

62488 **(NP—2903832) Max Planck project group for laser research. Annual report 1980.** (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Projektgruppe fuer Laserforschung). 1980. 173p. (In German). Max-Planck-Gesellschaft, Projektgruppe fuer laserforschung, D-8046 Garching bei Muenchen, Germany.

A description is given of experimental results, method, equipment of projects undertaken at the Institute. Research areas include plasma physics and high-power laser development (numerical simulation, particle diagnostics, target preparation, data acquisition), heavy ion fusion, laser chemistry (molecular halogen lasers, excimer laser optimization), laser spectroscopy and theory (measurement of molecular vibration relaxation in solid state surfaces, hyper Raman scattering), and stimulated Raman radiation from CO_2 laser beams in gaseous oxygen. 86 references, 58 figures.

62489 **(PPPL—1921) Gas-fueling studies in the PDX tokamak.** Dylla, H.F.; Blanchard, W.R.; Budny, R.; Fonck, R.J.; Owens, D.K.; Schmidt, G.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1982. Contract AC02-76CH03073. 25p. NTIS, PC A02/MF A01. Order Number DE82022233.

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The characteristics of gas-fueling of high power discharges in the PDX tokamak have been investigated using gas-flow, neutral pressure, plasma density, and Hα emission measurements. The efficiency of gas-fueling was measured for various plasma configurations by comparison of the measured gas-influx rates to the particle exhaust rates inferred from particle decay time measurements. We observe that the fueling efficiency decreases significantly with increasing plasma density as the ionization length for thermal neutrals becomes shorter than the width of the boundary plasma. Gas fueling rates required to maintain a given plasma density are considerably higher (by factors of 5 to 10) for diverted discharges compared to limiter discharges. This result is attributed to a lower effective recycling coefficient for diverted plasmas. We discuss the dependence of the particle balance on the following experimentally measured parameters: the particle containment time, system-pumping speed, and neutral pressure in the vicinity of the active pumps.

62490 **(PPPL—1927) Mode converters for generating the HE11 (gaussian-like) mode from TE01 in circular waveguide.** Doane, J.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1982. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01. Order Number DE82022226.

The HE11 mode in corrugated waveguide has a field distribution very close to that of an ideal gaussian mode. Its radiation pattern is symmetric about the waveguide axis and exhibits virtually no cross polarization. This work reports measurements on mode converters to transform the TE01 mode into HE11 for electron cyclotron heating (ECH) experiments. The first mode converter is a 28 degree bend in 1.094-inch I.D. circular waveguide which generates TM11 from TE01 with a measured efficiency of over 95% at 60 GHz. A second converter consists of a straight corrugated waveguide section of the same I.D. in which the corrugation depth increases gradually from zero to nominally a quarter wavelength. This section converts TM11 to HE11 with an efficiency of about 97%. The overall efficiency of conversion from TE01 to HE11 exceeds 91% over a measured range of 59.2 to 60.1 GHz.

62491 **(PPPL—1929) Optimization of steady-state beam-driven tokamak reactors.** Mikkelsen, D.R.; Singer, C.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1982. Contract AC02-76CH03073. 53p. NTIS, PC A04/MF A01. Order Number DE82022232.

Recent developments in neutral beam technology prompt us to reconsider the prospects for steady-state tokamak reactors. A mathematical reactor model is developed which includes the physics of beam-driven currents and reactor power balance, as well as reactor and beam system costs. This model is used to find the plasma temperatures which minimize the reactor cost per unit of net electrical output. The optimum plasma temperatures are nearly independent of β and are roughly twice as high as the optimum temperatures for ignited reactors. If beams of neutral deuterium atoms with near-optimum energies of 1 to 2 MeV are used to drive the current in an INTOR-sized reactor, then the optimum temperatures are typically T/sub e/ ≃ 12 to 15 keV and T/sub i/ ≃ keV for a wide range of model parameters. Net electrical output rises rapidly with increasing deuterium beam energy for E/sub b/ ≦ 400 keV, but rises only slowly above E/sub b/ ~ 1 MeV. We estimate that beam-driven steady-state reactors could be economically competitive with pulsed-ignition reactors if cyclic-loading problems limit the toroidal magnetic field strength of pulsed reactors to ≦ 85% of that allowed in steady-state reactors.

62492 **(PPPL-Q—39) Annual report covering the period October 1, 1980 to September 30, 1981.** Phillips, C.A.; Jones, N.D. (eds.). (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1981. Contract AC02-76CH03073. 98p. NTIS, PC A05/MF A01. Order Number DE82022158.

Research during this period is described for each of the following areas: (1) Princeton Large Torus, (2) Poloidal Divertor Experiment, (3) Spheromak, (4) smaller devices, (5) x-ray laser studies, (6) theory, (7) TFTR, (8) applied physics, (9) design studies for new devices, (10) advanced projects design and analysis, (11) engineering, (12) fabrication, operations, and maintenance (13) Projects Office, (14) Computer Division, (15) Administration, and (16) Graduate Education. (MOW)

62493 **(REPT—81-131) High beta equilibria of plasmas in the quasi-uniform current model: influence of shaping the plasma cross section and of the second order in the inverse aspect ratio.** Schuurman, W.; Bobeldijk, C. (FOM-Instituut voor Plasmafysica, Jutphaas (Netherlands)). Apr 1981. 32p. NTIS, PC A03/MF A01.

Analytical calculations of toroidal plasma equilibria in the high beta ordering were performed in the quasi-uniform current model, varying the shape of the poloidal plasma crosssection. The effect of the second order in an expansion in the inverse aspect ratio was determined for a plasma with elliptic crosssection. Analytical representation of curves with a shape deviating from an ellipse (e.g., racetrack, triangle, rectangle) enabled the treatment of high beta equilibria of plasmas having these curves as poloidal crosssection. A smooth current profile or a flat plasma crosssection allow higher values of beta p than a skin current or a vertically pointed crosssection. Also, D-shaping improves the equilibrium beta p especially at higher values of the ellipticity. The method of cross-section shaping allows, in principle, the extension to higher mode harmonic contributions. (ESA)

62494 **(SAND—82-1586C) Engineering aspects of particle-beam fusion systems.** Cook, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 5p. (CONF-821101—6). NTIS, PC A02/MF A01. Order Number DE82018645.

From ASME winter annual meeting; Pheonix, AZ, USA (14 Nov 1982).

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The Department of Energy is supporting research directed toward demonstration of DT fuel ignition in an Inertial Confinement Fusion (ICF) capsule. As part of the ICF effort, two major Particle Beam Fusion Accelerators (PBFA I and II) are being developed at Sandia National Laboratories with the objective of providing energetic light ion beams of sufficient power density for target implosion. Supporting light ion beam research is being performed at the Naval Research Laboratory and at Cornell University. If the answers to several key physics and engineering questions are favorable, pulsed power accelerators will be able to provide an efficient and inexpensive approach to high target gain and eventual power production applications.

62495 **(UCID—19444) Theory of the optimal design of straight-axis minimum-B mirror confinement configurations.** Hall, L.S. (Lawrence Livermore National Lab., CA (USA)). 6 Jul 1982. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01. Order Number DE83000654.

The design of modern straight-axis linked-mirror plasma-confinement configurations involves a balance between many competing requirements. The dipole and quadrupole components of magnetic induction required in one confinement region often do not match onto the fields of an adjacent region without complications that seriously affect particle drifts or confinement stability. Here, the relevant factors are set down together with the techniques for analytical optimization of the design of a general configuration. A general sufficient condition for the stability of an arbitrary guiding-center MHD equilibrium is derived. This condition makes explicit the stabilizing qualities of good normal curvature and diamagnetic axial current. The instability drive depends on two terms: one carries the sign of normal curvature and the other relates to the relative signs of geodeics curvature and geodesic torsion. The theory is applied to low-beta, large-aspect-ratio equilibria for which analytic expressions for the confining magnetic fields are known. Two optimizations are required to specify the arbitrary features of the quadrupole and dipole fields. One optimization is nonlinear and can be performed by the ordinary calculus of variations; the second optimization is linear and subject to the rules of game theory. Appropriate quality factors are obtained, thus giving the designer quantitative measures with which to balance design trade-offs.

62496 **(UCRL—15477) Nova output sensor system. Report 6197. Final report.** (Lawrence Livermore National Lab., CA (USA); Aerojet ElectroSystems Co., Azusa, CA (USA)). 30 Apr 1982. Contract W-7405-ENG-48. 140p. NTIS (US Sales Only). Order Number DE82019104.

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This report describes the Nova Output Sensor design developed by Aerojet ElectroSystems Company (AESC) for Lawrence Livermore National Laboratory. The sensor is an outgrowth of control and instrumentation work done by Aerojet during the Shiva Program and represents an integration of the previously developed alignment and diagnostic instruments developed under that program. The basic sensor configuration was developed under this contract during a concept definition phase in which extensive trade studies were used to define and optimize this three-color sensor.

62497 **(UCRL—86827) Nova control system: goals, architecture, and system design.** Suski, G.J.; Duffy, J.M.; Gritton, D.G.; Holloway, F.W.; Krammen, J.R.; Ozarski, R.G.; Severyn, J.R.; Van Arsdall, P.J. (Lawrence Livermore National Lab., CA (USA)). 19 May 1982. Contract W-7405-ENG-48. 25p. (CONF-820561—2). NTIS, PC A02/MF A01. Order Number DE82015909.

From 4. workshop on distributed computer control systems; Tallinn, USSR (24 May 1982).

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The control system for the Nova laser must operate reliably in a harsh pulse power environment and satisfy requirements of technical functionality, flexibility, maintainability and operability. It is composed of four fundamental subsystems: Power Conditioning, Alignment, Laser Diagnostics, and Target Diagnostics, together with a fifth, unifying subsystem called Central Controls. The system architecture utilizes a collection of distributed microcomputers, minicomputers, and components interconnected through high speed fiber optic communications systems. The design objectives, development strategy and architecture of the overall control system and each of its four fundamental subsystems are discussed. Specific hardware and software developments in several areas are also covered.

62498 **(UCRL—86910) X-ray backlighting characterization experiments performed with laser wavelengths of 1.06, 0.53, and 0.35 μm.** Matthews, D.L.; Campbell, E.M.; Ceglio, N. (Lawrence Livermore National Lab., CA (USA)). 1982. Contract W-7405-ENG-48. 24p. (CONF-820435—4). NTIS, PC A02/MF A01. Order Number DE82020177.

From CLEOS conference; Phoenix, AZ, USA (14 Apr 1982).

We report the conversion efficiency, xi/sub x/, for production of x-ray backlighting line sources from 1.4 keV to 8.6 keV as a function of laser wavelength, -pulselength and intensity. For K-shell x-ray line emission we observed only a moderate increase in xi/sub x/ when using a 0.35μm (instead of 1.06 μm) wavelength laser.

62499 **(UCRL—87059) Laser-plasma interaction experiments at laser wavelengths of 1.064 μm, 0.532 μm, and 0.355 μm.** Campbell, E.M.; Mead, W.C.; Turner, R.E. (Lawrence Livermore National Lab., CA (USA)). 1982. Contract W-7405-ENG-48. 31p. (CONF-820435—3). NTIS, PC A03/MF A01. Order Number DE82020170.

From CLEOS conference; Phoenix, AZ, USA (14 Apr 1982).

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The effect of laser wavelength on laser-plasma coupling is one of the critical issues facing the laser driven inertial confinement community. The advantages of using lasers with output wavelength less than 1 μm, such as enhanced absorption and hydrodynamic efficiency, reduction in parametric instabilities and corresponding suprathermal electron generation, have long been predicted theoretically.

62500 **(UCRL—87158) Streaked x-ray microscopy of laser-fusion targets.** Price, R.H.; Campbell, E.M.; Rosen, M.D.; Auerbach, J.M.; Phillion, D.W.; Whitlock, R.R.; Obenshain, S.P.; McLean, E.A.; Ripin, B.H. (Lawrence Livermore National Lab., CA (USA); Naval Research Lab., Washington, DC (USA)). Aug 1982. Contract W-7405-ENG-48. 35p. (CONF-820822—9). NTIS, PC A03/MF A01. Order Number DE82020848.

From 26. technical symposium and exhibition of the International Society for Optical Engineering; San Diego, CA, USA (21 Aug 1982).

An ultrafast soft x-ray streak camera has been coupled to a Wolter axisymmetric x-ray microscope. This system was used to observe the dynamics of laser fusion targets both in self emission and backlit by laser produced x-ray sources. Spatial resolution was 7 μm and temporal resolution was 20 ps. Data is presented showing the ablative acceleration of foils to velocities near 10^7 cm/sec and the collision of an accelerated foil with a second foil, observed using 3 keV streaked x-ray backlighting. Good agreement was found between hydrocode simulations, simple models of the ablative acceleration and the observed velocities of the carbon foils.

62501 **(UCRL—87347) Mechanical-engineering aspects of mirror-fusion technology.** Fisher, D.K.; Doggett, J.N. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1982. Contract W-7405-ENG-48. 8p. (CONF-821101—7). NTIS, PC A02/MF A01. Order Number DE82019240.

From ASME winter annual meeting; Pheonix, AZ, USA (14 Nov 1982).

The mirror approach to magnetic fusion has evolved from the original simple mirror cell to today's mainline effort: the tandem-mirror machine with thermal barriers. Physics and engineering research is being conducted throughout the world, with major efforts in Japan, the USSR, and the US. At least one facility under construction (MFTF-B) will approach equivalent energy breakeven in physics performance. Significant mechanical engineering development is needed, however, before a demonstration reactor can be constructed. The principal areas crucial to mirror reactor development include large high-field superconducting magnets, high-speed continuous vacuum-pumping systems, long-pulse high-power neutral-beam and rf-plasma heating systems, and efficient high-voltage high-power direct converters. Other areas common to all fusion systems include tritium handling technology, first-wall materials development, and fusion blanket design.

62502 **(UCRL—87532) Inertial-fusion-reactor studies at Lawrence Livermore National Laboratory.** Monsler, M.J.; Meier, W.R. (Lawrence Livermore National Lab., CA (USA)). Aug 1982. Contract W-7405-ENG-48. 16p. (CONF-820948—2). NTIS, PC A02/MF A01. Order Number DE82021616.

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

We present results of our reactor studies for inertial-fusion energy production. Design studies of liquid-metal wall chambers have led to reactors that are remarkably simple in design, and that promise long life and low cost. Variants of the same basic design, called HYLIFE, can be used for electricity production, as a fissile-fuel factory, a dedicated tritium breeder, or hybrids of each.

62503 **(UCRL—87735) Changing MFTF vacuum environment.** Margolies, D.; Valby, L. (Lawrence Livermore National Lab., CA (USA)). 19 Aug 1982. Contract W-7405-ENG-48. 24p. (CONF-821111—2). NTIS, PC A02/MF A01. Order Number DE82020728.

From 29. national symposium on American Vacuum Society; Baltimore, MD, USA (16 Nov 1982).

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The Mirror Fusion Test Facility (MFTF) vaccum vessel will be about 60m long and 10m in diameter at the widest point. The allowable operating densities range from 2×10^9 to 5×10^{10} particles per cc. The maximum leak rate of 10^{-6} tl/sec is dominated during operation by the deliberately injected cold gas of 250 tl/sec. This gas is pumped by over 1000 square meters of cryopanels, external sorbtion pumps and getters. The design and requirements have changed radically over the past several years, and they are still not in final form. The vacuum system design has also changed, but more slowly and less radically. This paper discusses the engineering effort necessary to meet these stringent and changing requirements. Much of the analysis of the internal systems has been carried out using a 3-D Monte Carlo computer code, which can estimate time dependent operational pressures. This code and its use will also be described.

62504 **Observation of cold, high-density plasma near the Doublet-III limiter.** Baker, D.R.; Snider, R.T.; Nagami, M. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 6, 807-811(Jun 1982).

Interferometer measurements on Doublet III indicate that a region of high-density cold plasma exists near the inside limiter. This cold plasma region appears above a certain threshold density in the main plasma and can be more than five times the average plasma density. The formation of the high-density cold region occurs somewhat before the maximum achievable plasma density.

62505 **Engineering problems of fusion research. Report on the 9th Symposium, Chicago, Illinois, USA, 26-29 October 1981.** Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). *Nuclear Fusion;* **22**: No. 6, 849-855(Jun 1982).

This paper reports on the Ninth Symposium on Engineering Problems of Fusion Research held the 26-29 October 1981 in Chicago. Session topics ranged from quality assurance to magnet and super conductors development, from diagnostics to plasma engineering and future reactor systems.

62506 **Ideal-MHD analysis of the stability of ISX-B high-beta plasmas.** Munro, J.K. Jr.; Charlton, L.A.; Strickler, D.J.; Cooper, W.A.; Hogan, J.T.; Swain, D.W. (Oak Ridge National Lab., TN (USA)). *Nuclear Fusion;* **22**: No. 5, 599-610(May 1982).

Plasmas with volume-averaged beta equal to 3% have been produced in beam-heated ISX-B discharges. Previous modelling of such ISX-B plasmas, at somewhat lower beta and with limited detail as regards plasma shape, has shown that high-n ballooning instabilities should be excited, although none is observed. The authors now use data that allow them to specify free-boundary equilibria, which are influenced by the ISX-B poloidal coil system and iron core, and compare these equilibria with criteria for ideal magnetohydrodynamic (MHD) stability to both low- and high-n number ballooning and kink modes. Both analytic estimates and codes are used in the comparison. It is found that the equilibria studied are predicted to be unstable to both low- and high-n modes, in contrast to the experimental results. Several candidates for resolving these differences are discussed.

62507 **Measurement of impurity concentrations and radiated power in the tandem mirror experiment.** Strand, O.T.; Moos, H.W. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Physics); Allen, S.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Fusion;* **22**: No. 5, 657-661(May 1982).

A study of the impurity emissions (300-1600 A) in the Tandem Mirror Experiment (TMX) is described. Brightness measurements obtained with three absolutely calibrated monochromators, each viewing a separate section of TMX, showed that the dominant impurities were oxygen, nitrogen, carbon, and titanium. In the end cells, oxygen was the most abundant impurity with a concentration of approximately $<2\%$; the neutral beams were a significant source of oxygen as in the 2XIIB experiment. In the central cell, the impurity concentrations were low: approximately $<0.4\%$ for each species. Emissions from carbon and oxygen in this region were reduced by titanium gettering of the vacuum chamber walls. Total radiative power losses due to impurities were $<10\%$ of the net trapped neutral-beam power.

62508 **Fusion reactor design-III. Report on the third IAEA technical committee meeting and workshop, Tokyo, Japan, 5-16 October 1981.** Iso, Y. (Japan Atomic Energy Research Inst., Tokyo); Stacey, W.M. Jr. (Georgia Inst. of Tech., Atlanta (USA)); Kulcinski, G.L. (Wisconsin Univ., Madison (USA)); Krakowski, R.A. (Los Alamos National Lab., NM (USA)); Carlson, G.A. (Lawrence Livermore National Lab., CA (USA)); Yamanaka, C. (Osaka Univ., Suita, Japan); Casini, G. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Igata, N. (Tokyo Univ. (Japan)). *Nuclear Fusion;* **22**: No. 5, 671-719(May 1982).

A brief summary is given of the plenary sessions of the Third IAEA Technical Committee Meeting and Workshop on Fusion Reactor Design and Technology. The large tokamak experiments now under construction have brought fusion research to the threshold of fusion reactor power. A number of major in-depth reactor design studies are reported such as the 650-MW INTOR near-term experimental fusion reactor based upon essentially current technology. Also reported are studies of commercial reactor designs. Results are given of the discussions of seven workshops that were based on the papers presented. These groups evaluated the current status and identified key problem areas for each in the following areas: near-term tokamaks, long-term tokamaks, toroidal systems (alternative concepts), open systems, inertial confinement systems (advanced fuels, hybrids, etc.), and fusion reactor materials. The importance of beginning now to prepare for the next major step in fusion reactor development was emphasized and the benefits of international co-operation were evident in the consensus reached in the INTOR results and the strong influence it has had on the direction of the leading national design efforts.

62509 **Helium behaviour in expanded boundary divertor discharges.** de Boo, J.C.; Brooks, N.H.; Degrassie, J.S.; Mahdavi, M.A.; Ohyabu, N.; Wesley, J.C. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 4, 572-576(Apr 1982).

Helium was injected into expanded boundary divertor discharges in Doublet III to evaluate the helium exhaust and enrichment capabilities of the divertor. Helium was found to enter the main body of the plasma readily, achieving a concentration similar to that without the divertor at a helium concentration in the main plasma of 5% of anti nsub(e), helium pressure of 5×10^{-5} torr was observed in the pumping duct with no enrichment of helium relative to atomic hydrogen, while at higher densities helium pressure decreased and significant de-enrichment was observed. Simplified calculations of the relative penetration depth of neutral hydrogen and helium are consistent with these results.

62510 **Radiated energy and impurity density changes during intensive hydrogen influx in the PLT tokamak.** Hinnov, E.; Hosea, J.; Hsuan, H.; Jobes, F.; Meservey, E.; Schmidt, G.; Suckewer, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **22**: No. 3, 325-332(Mar 1982).

During a discharge a puff of hydrogen is admitted, sufficient to more than triple the plasma density, and the resulting changes in various plasma parameters are determined. The absolute densities of various wall and limiter (carbon) materials are found to decrease by a substantial fraction, probably as a result of lowered peripheral temperature. The radiation pattern deduced from spectroscopically determined plasma composition is in good quantitative agreement with direct bolometric measurements. In the interior of the discharge, radiation constitutes only a small part of the power input. Neither the radiated power nor the power input changes very markedly as a result of the density rise, since the effects of temperature and plasma composition changes tend to compensate each other.

62511 **Study of current diffusion in Doublet III.** Stambaugh, R.D.; Blau, F.P.; Ejima, S.; Jahns, G.L.; Luxon, J.L.; Taylor, T.S.; Waltz, R.E. (General Atomic Co., San Diego, CA (USA)); Shimada, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). *Nuclear Fusion;* **22**: No. 3, 395-401(Mar 1982).

Current diffusion was studied in near-circular discharges in Double III when the plasma current was programmed to rise linearly from an initial steady level to a second, higher, steady level. Classical current diffusion was observed for Isub(p) up to 7MA.s^{-1}; discharges with Isub(p)>2MA.s^{-1}, however, disrupted at the transition from the current ramp to the second steady level.

62512 **High-density, low-q discharges with D-shaped and circular cross-sections in Doublet III.** Nagami, M.; Yoshida, H.; Shinya, K.; Yokomizo, H.; Shimada, M.; Ioki, K.; Izumi, S.; Kitsunezaki, A. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Jahns, G.L. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 3, 409-421(Mar 1982).

The maximum plasma current in Doublet III is found to be limited by disruptions when the limiter safety factor is approximately two. However, because of the strong toroidal and shaping-field effects on th rotational transform at the outer plasma edge associated with a vertical elongation of 1.5 D-shape, the safety factor qsub(a)sup(*) estimated from simple geometric considerations for D-shaped plasmas corresponds t values as low as 1.5. These discharges operate stably with considerably higher plasma current than most reactor design studies assume. These low-q discharges show excellent plasma performance: very flat spatial electron temperature profiles, high-density operation with anti nsub(e)R/Bsub(T) up to 7.8, and good energy confinement producing a volume-average β of up to 1% with Ohmic heating only. This operational regime appears to be applicable to future high-β tokamaks with D-shaped cross-sections.

62513 **Field reversal by rotating waves.** Fisch, N.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Watanabe, T. (Hiroshima Univ. (Japan)). *Nuclear Fusion;* **22**: No. 3, 423-427(Mar 1982).

Rotating waves have been suggested as a means of generating current that, in turn, can produce a compact-torus configuration. The practicality of this scheme is assessed with regard to stability and power requirements. The method of generating current is compared to other methods of non-Ohmic current drive.

62514 **Anisotropy and tail formation in ICRF-heated tokamak plasmas.** Blackfield, D.T.; Scharer, J.E. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering; Wisconsin Univ., Madison (USA). Dept. of Electrical Engineering). *Nuclear Fusion;* **22**: No. 2, 255-267(Feb 1982).

A local, two-dimensional (in velocity space), time-dependent, quasi-linear Ion Cyclotron Range of Frequencies (ICRF) Fokker-Planck model is used to study heating in PLT and NUWMAK reactor plasmas. It is found that PLT ICRF experimental results, including tail formation, are well modelled when charge-exchange, radial and radiation losses and Ohmic heating are incorporated. For the NUWMAK reactor parameters, the lower-radiofrequency power per resonant particle and high density provide an isotropic Maxwellian plasma describable by fluid models.

62515 **Stabilization of tearing modes in tokamaks using electron cyclotron heating.** Chan, V.; Guest, G. (General Atomic Co., San Diego, CA (USA)). *Nuclear Fusion;* **22**: No. 2, 272-276(Feb 1982).

Electron cyclotron heating (ECH) is shown to be effective in suppressing low-order tearing-mode instabilities in tokamaks. Stabilization through localized changes in the plasma current profile can be effected in tens of milliseconds with realistic microwave power densities. It is reasonable to expect that this technique could prevent major disruptions in tokamaks.

62516 **Preliminary particle scoop limiter measurements in PDX.** Jacobsen, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **22**: No. 2, 277-280(Feb 1982).

A plasma edge particle scoop limiter has been installed on the equator of the Princeton Divertor Experiment (PDX), a large tokamak. The scoop limiter is unique in that it is designed such that the plasma plugs the entrance throat, thereby impeding the return flow of neutralized gas to the discharge. Neutral-gas pressures of the order of 50 μm were measured inside the scoop. The pressure dependence on electron density in the scrape-off plasma at the throat entrance was stronger than linear.

62517 **STARFIRE: a commercial fusion tokamak power plant.** Baker, C.C. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **38**: 533-535(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62518 **Radiation shielding of major penetrations in tokamak fusion reactors.** Abdou, M.A.; Gohar, Y.; Jung, J. (ANL, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **38**: 553-554(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62519 **Coupled Monte Carlo/discrete ordinates calculations for ETF vacuum-pumping duct shielding.** Dudziak, D.J.; Seed, T.J.; Urban, W.T. (LANL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **38**: 554-555(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62520 **Radiation streaming in WITAMIR I.** Maynard, C.W. (Univ of Wisconsin, Madison, WI 53706). *Transactions of the American Nuclear Society;* **38**: 558-559(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62521 **Analysis of the ORNL radiation streaming integral experiments.** Alsmiller, R.G. Jr; Barnes, J.M.; Chapman, G.T.; Santoro, R.T.; Tang, J.S. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **38**: 561-562(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62522 **Neutron streaming analysis for shield design of the FMIT facility.** Carter, L.L. (Westinghouse Hanford, Richard, WA 99352). *Transactions of the American Nuclear Society;* **38**: 562-563(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62523 **Diagnostic penetration study for the TFTR.** Giarrusso, J.; Kolibal, J.; Ku, L.P. (PPPL, Princeton, NJ 08544). *Transactions of the American Nuclear Society;* **38**: 565-566(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62524 **Preliminary activation calculations for the poloidal divertor experiment.** Bohn, T.S.; Judd, J.L.; Nigg, D.W.; Scott, A.J. (EG&G Idaho, Idaho Falls, ID 83415). *Transactions of the American Nuclear Society;* **38**: 570-571(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62525 **Heating calculations of fusion blanket experiments in a fission reactor.** Bohn, T.S.; Judd, J.L.; Scott, A.J.; Wessol, D.E. (EG&G Idaho, Idaho Falls, ID 83415). *Transactions of the American Nuclear Society;* **38**: 571-573(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62526 **Blanket and shield nuclear analysis of a D-D tandem mirror reactor.** Conn, R.W.; Ghoniem, N.M.; Youssef, M.Z. (UCLA, Los Angeles, CA 90024). *Transactions of the American Nuclear Society;* **38**: 573-574(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62527 **Time-dependent radiation damage to the first wall of a heavy ion beam fusion reactor with porous tube protection.** Kulcinski, G.L.; Moses, G.A.; Sawan, M.E. (Univ of Wisconsin, Madison, WI 53706). *Transactions of the American Nuclear Society;* **38**: 574-575(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62528 **A coupled target-blanket neutronics and photonics analysis of a $Li_{17}Pb_{83}$ cooled heavy ion beam fusion reactor.** Moses, G.A.; Sawan, M.E.; Vogelsang, W.F. (Univ of Wisconsin, Madison, WI 53706). *Transactions of the American Nuclear Society;* **38**: 575-577(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62529 **Neutron and gamma-ray streaming calculations for the ETF neutral beam injectors.** Alsmiller, R.G. Jr.; Barnes, J.M.; Lilli, R.A.; Santoro, R.T. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **38**: 577-578(1981). (CONF-810606—).

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

62530 **New tungsten isotope evaluations for neutron energies between 0.1 and 20 MeV.** Arthur, E.D.; Philis, C.A.; Smith, A.B.; Young, P.G. (LANL, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **39**: 793-794(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

62531 **Calculations using new tungsten isotope evaluations.** Arthur, E.D.; Estes, G.P.; Little, R.C.; Seamon, R.E.; Soran, P.D. (LANL, Los Alamos, NM 897544). *Transactions of the American Nuclear Society;* **39**: 794-796(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

62532 **Nuclear performance of catalyzed DD AND DT blankets for process heat production.** Ragheb, M.M.H.; Salimi. (Univ of Illinois, Urbana, IL 60680). *Transactions of the American Nuclear Society;* **39**: 796-798(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

62533 **Analysis of ORNL fusion reactor blanket/shield integral experiments.** Alsmiller, R.G.; Barnes, J.M.; Chapman, G.T.; Santoro, R.T. (ORNL, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **39**: 798-799(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

62534 **Radioactivity, biological hazard potential, and afterheat levels in a deuterium-burning tandem mirror reactor.** Conn, R.W.; Youssef, M.Z. (UCLA, Los Angeles, CA 94080). *Transactions of the American Nuclear Society;* **39**: 799-802(1981). (CONF-811103—).

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

62535 **Magnetic mirror fusion research.** Post, R.F. (LLNL, Livermore, CA 94550). *Transactions of the American Nuclear Society;* **35**: 123-124(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

62536 **Advances in materials technology for fusion reactors.** Zwilsky, K.M. (DOE, Washington, DC 20555). *Transactions of the American Nuclear Society;* **35**: 125(1980). (CONF-801107—).

From ANS international conference; Washington, DC, USA (17 Nov 1980).

62537 **Low-aspect-ratio limit of the toroidal reactor - The spheromak.** Bussac, M.N. (Institute for Advanced Study, Princeton, N.J.); Rosenbluth, M.N. (Princeton University, Princeton, N.J.). pp 249-264 of Plasma physics and controlled nuclear fusion research 1978. Volume 3. Vienna, Austria; IAEA (1979).

From 7. conference on plasma physics and control; Innsbruck, Austria (23 Aug 1978).

The ideal and resistive MHD stability properties of a class of toroidal plasma configurations ('spheromaks') having internal toroidal and poloidal fields and external poloidal fields are considered. The reactor advantage of the spheromak is two-fold: (1) the maximum field strength at the external coils is about half the field at the plasma centre, rather than twice, as in a tokamak, and (2) a roughly spherical blanket can be used, rather than a blanket that links the plasma topologically. Taylor's criterion, which ensures stability against both ideal and resistive modes, has been applied to force-free spheromaks of unity aspect ratio. In the presence of a loosely fitting external conducting shell, oblate spheromaks are stable against all modes except short-wave surface kinks (which are an artifact of the idealized current density profile). The Mercier criterion gives a beta-limit below 1% however, at aspect ratio greater than or almost equal to 1, the beta-limit for representative spheromak models rises into the range 2-4%.

62538 **The Elmo Bumpy Torus /EBT/ reactor.** Uckan, N.A. (Oak Ridge National Laboratory, Oak Ridge, Tenn.); Batchelor, D.B. (Oak Ridge National Laboratory, Oak Ridge, Tenn.; Exxon Nuclear Co., Inc., Bellevue, Wash.). pp 343-356 of Plasma physics and controlled nuclear fusion research 1978. Volume 3. Vienna, Austria; IAEA (1979). Contract W-7405-ENG-26.

From 7. conference on plasma physics and control; Innsbruck, Austria (23 Aug 1978).

The EBT combines many of the most attractive features of both tokamaks and mirrors into an attractive reactor configuration: steady-state operation, potential for high beta, large aspect ratio, modular construction, favorable geometry for ease of maintenance, modest technology requirements, high Q value, and economic potential. Recent designs which incorporate the increased understanding from plasma research have lead to smaller reactors with easier and practical maintenance. Critical physics issues are discussed, and dimensionless parameter scalings are explored.

62539 **Impact of technology and maintainability on economic aspects of tokamak power plants.** Abdou, M.A.; Baker, C.C.; Brooks, J.; Clemmer, R.; Dennis, C.; Ehst, D.; Evans, K.; Harkness, S.; Kustom, R.; Maroni, V. (Argonne National Laboratory, Argonne, Ill.). pp 357-367 of Plasma physics and controlled nuclear fusion research 1978. Volume 3. Vienna, Austria; IAEA (1979).

From 7. conference on plasma physics and control; Innsbruck, Austria (23 Aug 1978).

Results of system studies on the primary energy conversion, energy storage and transfer, tritium and vacuum subsystems of a tokamak reactor are presented. These results quantify technology choices and maintainability on the economics of tokamak power plants. It is found that the expensive refractory alloys must offer a factor of three or greater advantage in lifetime compared to stainless steel in order that their costly development should have a reasonable benefit-to-cost ratio. Five reactor concepts are analyzed in terms of their scheduled maintenance requirements for replacing the first wall and blanket. The total downtime is found to vary from approximately 100 days to 500 days for a single replacement of the entire first wall and blanket. Substantial reduction in the power supply requirements and costs over previous estimates seems possible. The emergency air detritiation system is found to be a major cost item.

99 GENERAL AND MISCELLANEOUS

9901 Management

REFER ALSO TO CITATION(S) 62564

62540 **(GAO/CED—82-28) Problems in managing and planning of information resources persist at the Army Corps of Engineers.** Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 9 Jun 1982. 61p. General Accounting Office, PO Box 6015, Gaithersburg, MD 20760.

Weak planning and control have led to ineffective and inefficient management, acquisition, and use of information resources by the Army Corps of Engineers. These management problems have affected a major computer hardware replacement program, causing delays in obtaining needed computer resources. With an estimated life-cycle cost exceeding $1 billion over the next several years in this program, the Corps needs to establish a stronger management structure. By adhering to the intent of the Paperwork Reduction Act of 1980, the Corps can establish a framework for strengthening its management of information resources. GAO's principal recommendation is that the Corps establish a central management office headed by a senior official to provide needed direction and leadership and to correct persistent management deficiencies.

62541 **(NP—2905971) United States Government Manual 1982/83.** (General Services Administration, Washington, DC (USA)). 1 Jul 1982. 920p. GPO.

As the official handbook of the Federal Government, The United States Government Manual provides comprehensive information on the agencies of the legislative, judicial, and executive branches. The Manual also includes information on quasi-official agencies, international organizations in which the United States participates, and boards, committees, and commissions. A typical agency description includes a list of principal officials, a summary statement on the agency's purpose and role in the Government, a brief history of the agency, including its legislative or executive authority, a description of its programs and activities, and a Sources of Information section. This last section provides information on consumer activities, contracts and grants, employment, publications, and many other areas of citizen interest.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 61834, 61839

62542 **(CONF-820810—12) Parameter identifiability for partial differential equations.** Travis, C.C.; White, L.W. (Oak Ridge National Lab., TN (USA); Oklahoma Univ., Norman (USA). Dept. of Mathematics). 1982. Contract W-7405-ENG-26. 2p. NTIS, PC A02/MF A01. Order Number DE82020910.

From 10. international mathematics and computers simulation congress on systems simulation and scientific computation; Montreal, Canada (9 Aug 1982).

Portions of document are illegible.

The direct method of parameter identifiability is shown to hold for linear parabolic partial differential equations. This is in contrast to other methods of parameter identifiability which, while they hold for finite dimensional lumped systems, fail to extend to partial differential equations. It is hoped that the direct method will provide some insight into the many unanswered questions concerning parameter identifiability of partial differential equations.

62543 **(CONF-8108138—1) Least-squares adjustment of large-scale geodetic networks by orthogonal decomposition.** George, J.A.; Golub, G.H.; Heath, M.T.; Plemmons, R.J. (Waterloo Univ., Ontario (Canada). Dept. of Computer Science; Stanford Univ., CA (USA). Dept. of Computer Science; Oak Ridge National Lab., TN (USA); North Carolina State Univ., Raleigh (USA)). 1981. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01. Order Number DE82020905.

From Symposium on geodetic networks and computations; Munich, F.R. Germany (30 Aug 1981).

This article reviews some recent developments in the solution of large sparse least squares problems typical of those arising in geodetic adjustment problems. The new methods are distinguished by their use of orthogonal transformations which tend to improve numerical accuracy over the conventional approach based on the use of the normal equations. The adaptation of these new schemes to allow for the use of auxiliary storage and their extension to rank deficient problems are also described.

62544 (DOE/EV/10298—3, pp VIII.1-VIII.14) **Water quality data evaluation study.** Meglen, R.R. (Univ. of Colorado, Denver); Erickson, G. 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1979-1982.

The purpose of this study was to apply advanced data analysis techniques, capable of handling many variables simultaneously, to the large number of measurements of water constituents and physical characteristics from the Logan Wash area. Use of these data analysis techniques was prompted by the expectation that, because of the number and intermittent nature of the measurements, standard statistical techniques would fail to extract the significant relationships hidden in the data set. The advanced data analysis techniques used by Infometrix scientists in this study are specifically designed to address this type of problem. The approach used is referred to as Pattern Recognition. It is an iterative process between human analysts, having some knowlege of the problem at hand, and applied computer methods that can deal with many variables at the same time. The results of this approach are outlined. The data included measurements for up to 77 features on 700 water samples taken from 31 sampling sites in and around Retort 6 at Logan Wash on the edge of the Piceance Creek Basin region in Colorado, over a five year period from mid-1975 to early 1981. A sketch of the terrain contours and features with the approximate locations of the stream, bedrock and alluvial sampling sites is shown. The data studied were gathered by Occidental Oil Shale, Inc. (OXY), under a cooperative agreement with the Department of Energy. The major goals of the data analysis covered concerns such as determining baseline water chemistries, defining contamination and the affected areas, and examining analytical and experimental methods.

62545 (DOE/EV/10298—4, pp VII.B1-VII.B12) **Water quality data evaluation study.** Meglen, R.R. (Univ. of Colorado, Denver); Erickson, G. 1982. NTIS, PC A16/MF A01.

In Oil shale environmental research and coordination. Progress report, 1981-1982.

The objectives are to apply advanced data analyses techniques, such as Pattern Recognition, to large oil shale-related water quality data bases to describe the water chemistries, ascertain whether contamination had occurred, determine the minimum number of parameters required, examine the need to improve analytical precision, and determine the optimum monitoring frequency. Water quality monitoring data were examined for Retort 6 at Occidental Oil Shale's Logan Wash operation. No major differences occurred between pre-burn and post-burn data. There are significant differences between types of waters (alluvial, deep groundwater, and stream sites) and between different wells. The effect of the sill pillar collapse was seen on two monitoring wells. The analysis shows that 90% of the information which separates the waters into different groups was contained in 12 of the 77 measured parameters. These 12 represent the preferred variables. An optimum monitoring program is recommended using a greatly reduced data set, but a somewhat higher frequency. It is recommended that Li is the most important variable in need of improved analytical precision. Environmental monitoring programs are expensive and typically generate masses of data, most of which is inadequately evaluated. This study shows that pattern recognition techniques provide a method for extracting considerably more information out of these large data bases and for devising optimal monitoring programs which provide more sensitive and rigorous means of detecting excursions at a much lower cost. The technique also provides an efficient means of summarizing large amounts of data.

62546 **(EGG—1183-1841) Implementing a structured process-control language with macros.** Ritenour, R. (EG and G, Inc., Las Vegas, NV (USA)). 1982. Contract AC08-76NV01183. 24p. (CONF-820515—8). NTIS, PC A02/MF A01. Order Number DE82021366.

From Spring DECUS symposium; Atlanta, GA, USA (10 May 1982).

Portions of document are illegible.

Implementing a high level language for a specialized application doesn't have to be a major undertaking. The tools provided by the PDP-11 Macro assembler make it possible to create very readable block structured programs. Such a language was devised so that Lawrence Livermore Chemists could describe procedures for controlling gas flow in their gas analysis system. This paper discusses the language implementation and shows how to make an assembly-time stack to implement the control structures of the language.

62547 **(LA—9111-M-Rev.) FITS: a function-fitting program.** Balestrini, S.J.; Chezem, C.G. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 28p. NTIS, PC A03/MF A01. Order Number DE82021259.

Portions of document are illegible.

FITS is an iterating computer program that adjusts the parameters of a function to fit a set of data points according to the least squares criterion and then lists and plots the results. The function can be programmed or chosen from a library that is provided. The library can be expanded to include up to 99 functions. A general plotting routine, contained in the program but useful in its own right, is described separately in Appendix A. An example problem file and its solution is given in Appendix B.

62548 **(LA—9501-MS) PERFLD: a FORTRAN subroutine to calculate first-order perturbations for two-dimensional symmetric multipoles.** Wadlinger, E.A. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01. Order Number DE82021271.

A FORTRAN subroutine, PERFLD, is presented that calculates perturbation effects for two-dimensional symmetric multipoles (electric or magnetic). PERFLD uses the algorithms and tables from First Order perturbation Effects in Iron-Dominated Two-Dimensional Symmetrical Multipoles by K. Halbach, Lawrence Berkeley Laboratory. The perturbations considered are error excitation, pole displacement, and rotation.

62549 **(LA—9503-MS) Interconnecting computers with the high-speed parallel interface.** Tolmie, D.E.; Dornhoff, A.G.; Tenbrink, S.C. (Los Alamos National Lab., NM (USA)). Aug 1982. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01. Order Number DE82021260.

A variety of local computer network architectures have been evaluated for use in the Los Alamos National Laboratory Central Computing Facility in support of scientific research at the Laboratory. A store-and-forward switched message system built around hardware products known as High-Speed Parallel Interfaces (HSPIs) was determined to be superior in this application to the more conventional contention bus systems. The HSPI interfaces, along with some dedicated computers used as intermediate switching nodes, implement this store-and-forward architecture and form the backbone of the Integrated Computer Network (ICN). The HSPI channel standard was developed at Los Alamos for the interconnection of computers of different manufacture. This standard intercomputer interface is used for passing data and messages via the I/O channels of the different computers. Reliable full-duplex point-to-point data transfers at speeds up to 50 million bits per second are accommodated. Extensive error detection and error correction capabilities are included in the HSPI hardware. HSPIs are currently in around-the-clock use at Los Alamos, interconnecting the computers of one of the world's most powerful computer networks. This report discusses the HSPI specifications and use of the HSPIs in the network. The Los Alamos network architecture and comparisons to a contention bus architecture are also discussed.

62550 **(PTB-FMRB—81) Routines for interface-approach for the Siemens 300 computer.** Schuster, H.J.; Hora, C. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Forschungs- und Messreaktor). Oct 1980. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE82903548.

A description is given of interface-approach routines that are generally applicable to the automation of measuring and control processes through the use of Siemens computers at the German Federal Physical-Technical Institute. The routines facilitate the simple and practical realization of data transmission (including block communication) between the computer and process apparatus as well as the timely coordination of several simultaneous processes (alarm adaptation) and interface testing. 3 references, 3 tables.

62551 **(SAND—82-1909C) Preliminary report on the cryptanalysis of Merkle-Hellman knapsack cryptosystems.** Brickell, E.F.; Davis, J.A.; Simmons, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1982. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01. Order Number DE82020355.

A study of the algorithm and the underlying mathematical concepts of A Polynomial Time Algorithm for Breaking Merkle-Hellman Cryptosystems, by Adi Shamir, is presented. Ways of protecting the Merkle-Hellman knapsack from cryptanalysis are given with derivations. (GHT)

62552 **(UCID—19347) LINCS session, presentation, common application/service protocols common across applications/service.** Watson, R.W. (Lawrence Livermore National Lab., CA (USA)). 19 Mar 1982. Contract W-7405-ENG-48. 60p. NTIS, PC A04/MF A01. Order Number DE82016085.

The Livermore Network Communication System (LINCS) is a layered architecture designed to support distributed computing. This document contains protocol specifications and conventions for protocols in three LINCS layers, the Session Layer (Layer 5), Presentation Layer (Layer 6), and the lower sublayers of the Application Layer (Layer 7). We briefly review the functions of each of these layers. The active communicating entities in LINCS are processes, where a process is informally understood as an instance of a program in execution. Processes communicate through ports. Ports are identified by globally unique identifiers called addresses. A pair of ports defines a full duplex information channel called an association. LINCS protocols have been explicitly designed for minimum delay (there are no "connection" opening or closing message exchanges) and for maximum throughput.

62553 **(UCID—19544) Security policy for distributed systems.** Fletcher, J.G. (Lawrence Livermore National Lab., CA (USA)). 6 Apr 1982. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01. Order Number DE82022517.

This security policy for distributed computing systems is modeled after the security considerations that apply to the noncomputer world of human beings, paper documents, and lockable repositories. However, the computer world differs from the noncomputer world in significant ways, and one should not expect a full analogy between them in regard to security matters. For example, the distinctions among looking at a document, keeping it, and copying it are easily made in the noncomputer world but are difficult or even impossible to make in the computer world. A distributed computing environment involves concepts which are relevant to an exposition of its security policy.

62554 **(UCID—19551) SATER/LLNL: an interactive identification/estimation/control package.** Candy, J.V.; Journeay, C.H. (Lawrence Livermore National Lab., CA (USA)). 1 Sep 1982. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01. Order Number DE82021009.

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This issue of the computer program newsletter focuses on SATER/LLNL - an interactive code for identification, estimation, and classical control. A brief description of the SATER/LLNL operation is included as well as a sample session. Attached is the fundamental reference that details more of the package.

62555 **(UCID—30194) Piecewise Cubic Hermite Interpolation Package. Final specifications.** Fritsch, F.N. (Lawrence Livermore National Lab., CA (USA)). Aug 1982. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01. Order Number DE82021008.

This document contains the specifications for PCHIP, a new Fortran package for piecewise cubic Hermite interpolation of data. It features software to produce a monotone and visually pleasing interpolant to monotone data. Such an interpolant may be more reasonable than a cubic spline if the data contains both steep and flat sections. Interpolation of cumulative probability distribution functions is another application.

62556 **(UCRL—53310) Local-order-estimating Markovian analysis for noiseless source coding and authorship identification.** Roberts, M.G. (Lawrence Livermore National Lab., CA (USA)). Jun 1982. Contract W-7405-ENG-48. 98p. NTIS, PC A05/MF A01. Order Number DE82022033.

Thesis. Submitted to Stanford Univ., CA.

The objective of noiseless source coding or noiseless data compression is to reversibly remove probabilistic redundancies in the input symbol stream to a communication channel, thereby obtaining improved data transmission rates. Whereas the entropy of the input stream is the crucial quantity which limits that improvement, practical implementation presupposes a model of the input symbol stream which experimentally exhibits an entropy value less than the full per-symbol uncertainty of the data stream's alphabet or dictionary. For natural English text, there exists a significant gap between the performance of such models and the estimated entropy of English as derived from various tests with human subjects. We present a computer implemented technique (LOEMA: Local Order Estimating Markovian Analysis) which eliminates that gap; the algorithm predicts English text with an experimental entropy value equaling, and in some cases bettering, values obtained with human subjects. For a 27 symbol alphabet, we achieve a global uncertainty of less than 1.4 bits per symbol, and local entropy estimates as low as 1.12 bits per symbol. A windowed entropy estimate yields information on local changes in the source process, which in various texts correlates with changes in authorship or writing style.

62557 **(UCRL—87414) Streams and iteration in VAL additions to a data-flow language.** McGraw, J.R.; Skedzielewski, S.K. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA). Dept. of Applied Science). 1982. Contract W-7405-ENG-48. 11p. (CONF-821002—1). NTIS, PC A02/MF A01. Order Number DE82012260.

From 3. international conference on distributed computing systems; Miami, FL, USA (18 Oct 1982).

This paper presents several proposals for modifications and extensions to the VAL language. First, we propose a modification of the iteration construct to improve readability. Second, we propose extensions to the language to allow streams. The stream additions enhance possibilities for pipeline concurrency and allow input and output to be specified.

62558 **(UCRL—87473) Bounds of resource sharing in protocol translation.** Ong, M.M. (Lawrence Livermore National Lab., CA (USA)). 26 Mar 1982. Contract W-7405-ENG-48. 4p. (CONF-821006—1). NTIS, PC A02/MF A01. Order Number DE82015192.

From 7. conference on local computer networks; Minneapolis, MN, USA (12 Oct 1982).

Given known amounts of network resources in two different networks, we want to determine the portion of the resources that can participate in protocol translation.

62559 **(UCRL—87612) CAMAC instrumentation in an HP/1000 environment.** Telford, S.J. (Lawrence Livermore National Lab., CA (USA)). 6 Aug 1982. Contract W-7405-ENG-48. 16p. (CONF-820847—1). NTIS, PC A02/MF A01. Order Number DE82020344.

From International Users Group conference on HP 1000; Long Beach, CA, USA (30 Aug 1982).

Portions of document are illegible.

Experimental environments often have very diverse and demanding data acquisition requirements. This paper describes how we have expanded our HP data acquisition computer system to include the CAMAC standard of instrumentation and interface. A brief description of the CAMAC standard will be presented followed by hardware and software implementation details of the CAMAC standard on HP computers. We have chosen to implement this standard using a commercially available crate controller and our own software package. The CAMAC software library allows the user to perform all the basic CAMAC functions as well as transfer data to and from CAMAC modules in a number of different modes. Details of this library will be presented including manipulation of the crate controller and error handling. I/O performance of the MARS system using this library will also be presented. Included will be a list of published literature concerning the standard and a list of CAMAC equipment suppliers. This paper will introduce the HP 1000 computer user to the CAMAC standard of instrumentation and show how the MARS experiment at Lawrence Livermore National Laboratory has implemented this standard.

62560 **(UCRL—87759) Validation of a discrete-event computer model of Network Systems Corporation's Hyperchannel.** Watson, W.B. (Lawrence Livermore National Lab., CA (USA)). 21 Jun 1982. Contract W-7405-ENG-48. 17p. (CONF-821006—3). NTIS, PC A02/MF A01. Order Number DE82019107.

From 7. conference on local computer networks; Minneapolis, MN, USA (12 Oct 1982).

Performance measurements of Network Systems Corporation's Hyperchannel have validated its discrete event simulation in use at the Lawrence Livermore National Laboratory (LLNL). Two independent groups performed the measurements: one at the University of Minnesota and the other at LLNL.

62561 **(USGS-OFR—81-556) Research on uranium resource models. Part IV. Logic: a computer graphics program to construct integrated logic circuits for genetic-geologic models. Progress report.** Scott, W.A.; Turner, R.M.; McCammon, R.B. (Geological Survey, Denver, CO (USA)). 1981. Contract AI13-81GJ01701. 21p. NTIS, PC A02/MF A01. Order Number DE82021830.

Portions of document are illegible.

Integrated logic circuits were described as a means of formally representing genetic-geologic models for estimating undiscovered uranium resources. The logic circuits are logical combinations of selected geologic characteristics judged to be associated with particular types of uranium deposits. Each combination takes on a value which corresponds to the combined presence, absence, or don't know states of the selected characteristic within a specified geographic cell. Within each cell, the output of the logic circuit is taken as a measure of the favorability of occurrence of an undiscovered deposit of the type being considered. In this way, geological, geochemical, and geophysical data are incorporated explicitly into

potential uranium resource estimates. The present report describes how integrated logic circuits are constructed by use of a computer graphics program. A user's guide is also included.

62562 **FPPAC: a two-dimensional multispecies nonlinear Fokker-Planck package.** McCoy, M.G.; Mirin, A.A.; Killeen, J. (Lawrence Livermore National Lab., CA). *Computer Physics Communications;* **24**: No. 1, 37-61(Sep 1981). Contract W-7405-ENG-48.

The complete nonlinear multispecies Fokker-Planck collision operator for a plasma in two-dimensional velocity space is solved. The operator is expressed in terms of spherical coordinates (nu = speed, θ = angle between velocity and magnetic field directions, phi = azimuthal angle) under the assumption of azimuthal symmetry. Provision is made for additional physics contributions. The Fokker-Planck equation is solved using finite differences. Spatial derivatives are approximated by central differences. Time-advancement is accomplished through either implicit operator splitting, an alternating direction implicit (ADI) algorithm, or fully implicit differencing. (In the latter case the user must supply his own nine-banded linear systems solver.) The Fokker-Planck coefficients and their derivatives are computed by expanding the distribution functions and the Rosenbluth potentials in Legendre series, and equating the respective series coefficients.

62563 **A specific proposal for data handling of the optical array.** Theriot, D. (Fermi National Accelerator Laboratory, Batavia, Ill.). pp 172-177 of DUMAND summer workshop, University of California, La Jolla, CA, July 24-September 2, 1978, proceedings. Volume 1 - array studies. Roberts, A. La Jolla, CA; DUMAND Scripps Institution of Oceanography (1979).

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

The tube, string, end and central stations setup and costs, and late signal processing are described for a specific DUMAND array. Considering that the two phototubes on each sensor have a 30 nsec propagation time, it is suggested that their output be summed, then divided into two channels, one to the fast logic thresholds, the other to the digitizing and storage electronics. Late signal processing is necessary due to the characteristic 2 microsec delay of the afterglow in a large hadronic shower, and to automatically cancel bioluminescence. String stations will relay fast trigger pulses to end stations, format data, and control all threshold and voltage settings of the tube stations, while the end stations, each with 63 cables containing 1, 2, or 3 bipolar pulses separated by 150 nsec, will relay instructions to string and tube stations. The central station will compute the relevant time windows during triggering cascades, and transmit typically 114,000 bits of data transmission per event to shore.

9903 Information Handling

REFER ALSO TO CITATION(S) 61600

62564 **(DOE/TIC—4045-S2) Index to conference titles: selected conferences cited in the Energy Data Base 1977-1982.** Vannoy, D.M. (ed.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). May 1982. 636p. NTIS, PC A99/MF A01. Order Number DE82014296.

Portions of document are illegible.

This publication cites energy-related conferences, meetings, symposia, and congresses within the programmatic interests of the US Department of Energy. It supplements Index to Conference Titles: Selected Conferences Cited in the ERDA Data Base 1972-1977, TIC-4045-S1, August 1977, and includes conferences held since January 1, 1977, which have been assigned a number in the CONF- report number series. The CONF- number is a six- or seven-digit code. The first two digits represent the years in which the conference was held; the next two represent the month; and the remaining digits are the accession number assigned by the DOE Technical Information Center (TIC).

62565 **(INIS-mf—6714, pp vp) Review of ANS-10 standards and activities.** Poetschat, G.R. 1981. Dep. NTIS (US Sales Only).

From ANS/ENS joint topical meeting on mathematical methods in nuclear engineering; Munich, F.R. Germany (27 Apr 1981).

The ANS-10 Standards Subcommittee is sponsored by the Mathematics and Computations Division of the American Nuclear Society. The scope of the ANS-10 Subcommittee includes the development of standards which will promote effective utilization and enhance the reliability of computer programs throughout the nuclear community. The intent of such standards is to improve ease of use, facilitate the exchange, and simplify the conversion of programs. These standards are to be applied during the computer program development process. The development process is the mechanism that creates special properties such as adequate documentation, verification and validation results, ease of use and portability in computer programs which improve reliability and promote effective use. ANS-10 has developed standards for Documentation of Digital Computer Programs, Programming Practices to Facilitate the Interchange of Digital Computer Programs, and Guidelines for Considering User Needs in Computer Program Development. The Documentation and Programming Practices Standards are presently being revised. ANS-10 is presently writing a new standard on verification and validation of computer programs.

62566 **(NP—2905970) Energy information guidance manual.** Kocher, P. (New York Inst. of Tech., Old Westbury (USA). Center for Energy Policy and Research). 1982. 309p. New York Inst. of Tech., Old Westbury, NY 11568.

This manual seeks to increase states' self-sufficiency in the acquisition, selection, development and sharing of energy information materials, and to assist state energy agencies and related offices which experience employee turnover to train new personnel rapidly. The Manual distills pertinent aspects of the Center for Energy Policy and Research experience in providing energy information to a wide clientele and incorporates valuable ideas and suggestions which many state energy officials conveyed to our staff personnel during visits over the past few years and in seminars conducted in 1981. Elements of specific programs can be adopted - or adapted - by other states. The pooling of states' experiences on difficult information problems can lead to joint efforts toward quicker, less expensive or more effective solutions. It is the interchange and testing of ideas by the many state officials with hands-on program experience that provide many of the practical suggestions in the Manual.

62567 **(ORNL—5908) Application of group theory to data reduction.** Perey, F.G. (Oak Ridge National Lab., TN (USA)). Sep 1982. Contract W-7405-ENG-26. 77p. NTIS, PC A05/MF A01. Order Number DE82021113.

The analysis within the framework of a theory of what was observed in experiments is essential to the testing of theories and is fundamental to physics. It is shown in this report how group theory can be used to provide a general method of data reduction whereby only the laws of a particular theory are used in the analysis of observations. This application of group theory involves introducing a group of transformations of the physical system upon which the observations were made. This group of transformations leaves invariant the entities of the theory corresponding to the observations made but transforms the entities that were not observed from what they are presumed to be in this theory into what they are not, called possibilities for what they are. This group of transformations is called the possibilities-generating group for the entities for which the observations are being reduced. Since possibilities for entities of theories so obtained are functionals of a known group of transformations, the subsequent use of these possibilities in the theories must be made consistent with the theory of representations of groups. There is a well-known invariant associated with functionals of group elements which is invariant with respect to the parametrization of this group. It is the normalized volume measure in the group manifold of the possibilities-generating group. In this report this invariant measure is called the physical probability of the possibilities since it is a probability measure which has a Borel algebra. The above proposed method of data reduction allows us to deal unambiguously with the uncertainties in entities of physical theories obtained from all of the observations made in experiments and the

distinction between systematic and statistical uncertainties disappears. Concrete realizations of possibilities-generating groups are given and explanations in group theoretical terms are offered for several important intuitive notions related to probabilities.

9905 Civilian Defense

62568 **(NP—2906227) Assessment of combined effects of blast and fire on personnel survivability. Final report.** Longinow, A.; Waterman, T.E.; Takata, A.N. (IIT Research Inst., Chicago, IL (USA)). Jun 1982. 184p. Federal Emergency Management Agency, 1725 I St., NW, Washington, DC.

Portions of document are illegible.

The objective of the study described was (1) to perform a preliminary analysis of hazards to sheltered personnel in a blast-fire environment produced by the detonation of a 1 MT nuclear weapon near the ground surface, and (2) to lay the basic groundwork for developing a consistent, formal methodology for estimating the probability of people survival in a blast-fire environment. A portion of a city consisting of identical, single-family framed residences and three types of below-grade personnel shelters located in selected areas was formulated and subjected to a simulated, single weapon nuclear weapon attack. Zones of structural blast damage were identified and debris distribution in selected areas was determined. Debris piles were described in spacial coordinates and composition (combustible, noncombustible) at various locations of the city blocks. Time dependent fire effects were determined using existing fire ignition and fire spread computer programs developed at IITRI. Hazards were quantified and the probability of people survival was estimated in terms of shelter effectiveness when located in different zones of blast damage. The three personnel shelters included (1) a conventional wood framed basement upgraded to provide additional blast resistance, (2) a conventional basement with a reinforced concrete overhead slab, and (3) an expedient, pole type below-grade shelter. The last shelter listed proved to be the most effective of the three in all blast damage zones and fire environments considered in this study.

CORPORATE AUTHOR INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Academy of Natural Sciences, Avondale, PA (USA). Stroud Water Research Center
Geographic analysis of thermal equilibria: a bioenergetic model for predicting thermal response of aquatic-insect communities. Technical progress report, January 1, 1981-December 31, 1982, 7:62032 (DOE/EV/10259—T2)

Adelphi Research Center, Inc., Garden City, NY (USA)
Commercial-sector coal/oil-slurry demonstration program. Final report, 7:60836 (NYSERDA—81-25)

Aerojet ElectroSystems Co., Azusa, CA (USA)
Nova output sensor system. Report 6197. Final report, 7:62496 (UCRL—15477)

Aerospace Corp., El Segundo, CA (USA)
Plasma and electric field boundaries at high and low altitudes on July 29, 1977, 7:62228 (NASA-CR—165118)

Aerospace Systems, Inc., Burlington, MA (USA)
ASI/Pinson 1-kW high-reliability wind system. Phase II. Prototype construction and testing, 7:61232 (RFP—3301)

AGIP Nucleare, Milan (Italy)
Villaverla 1 well. Interpretation of production tests. Final report, 7:61168 (EUR—7113-IT)

Agricultural Research Service, Peoria, IL (USA). North Central Region
Energy research for the farm: an overview. Agriculture Information Bulletin No. 447, 7:61135 (NP—2906044)

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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	7:61699	LBL—14735
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AC03-78ET11300	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
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AC03-78ET27146	**Vetter Research, Costa Mesa, CA (USA)**	
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AC03-79CS30035	**Dunham-Bush, Inc., West Hartford, CT (USA)**	
	7:61125	DOE/CS/30035—T2
AC03-79SF10542	**Sigma Research, Inc., Richland, WA (USA)**	
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AC03-80ET34034	**General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.**	
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AC03-81ER30012	**SRI International, Arlington, VA (USA)**	
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AC04-76DP00053	**Mound Facility, Miamisburg, OH (USA)**	
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AC04-76DP00487	**Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)**	
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AC04-76DP00613	**Bendix Corp., Kansas City, MO (USA)**	
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AC04-76DP00789	**Sandia National Labs., Albuquerque, NM (USA)**	
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	Sandia National Labs., Albuquerque, NM (USA)	
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	7:60962	SAND—82-0819
	7:60963	SAND—82-1200
	7:60995	NVO—247
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	7:61004	SAND—82-0547
	7:61005	SAND—82-1176
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	7:61113	SAND—81-7085/12
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	Budd Co., Fort Washington, PA (USA). Technical Center	
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	Sandia National Labs., Albuquerque, NM (USA)	
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	California Univ., Los Angeles (USA). School of Engineering and Applied Science	
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	Sandia National Labs., Albuquerque, NM (USA)	
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	Brookhaven National Lab., Upton, NY (USA)	
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	Sandia National Labs., Albuquerque, NM (USA)	
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	7:61537	NUREG/CR—2594
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AC04-76DP03533	**Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant**	
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	Enertech, Norwich, VT (USA)	
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AC05-76OR00033	**Oak Ridge Associated Universities, Inc., TN (USA)**	
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AC05-82ER53131	**Austin Research Associates, Inc., TX (USA)**	
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AC06-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
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AC06-76RL01830	**Battelle Memorial Inst., Columbus, OH (USA). National Waste Terminal Storage Integration**	
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	Battelle Pacific Northwest Labs., Richland, WA (USA)	
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AC06-76RL01837	**Hanford Environmental Health Foundation, Richland, WA (USA)**	
	7:62118	HEHF—22
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AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Energy Systems Group**	
	7:61000	RHO-BW-SA—190
	Kaiser Engineers, Oakland, CA (USA)	
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	Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations	
	7:62196	RHO-BW-SA—201-P
AC07-76ID01570	**Conservation Foundation, Washington, DC (USA)**	
	7:60979	DOE/NBM—2021741
	Idaho National Engineering Lab., Idaho Falls (USA)	
	7:61074	IDO—10104
	EG and G Idaho, Inc., Idaho Falls (USA)	
	7:61159	DOE/ID/12101—5
	7:61309	NUREG/CR—2757
	Pacific Northwest Lab., Richland, WA (USA)	
	7:61319	GEND—024
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	Battelle Columbus Labs., OH (USA)	
	7:61502	GEND—015
	Hartford Graduate Center, CT (USA)	
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AC07-77CS40040	**Institute of Gas Technology, Chicago, IL (USA)**	
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AC07-78CS40191	**National Food Processors Association, Berkeley, CA (USA)**	
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AC07-78ET28424	**Ore Ida Foods, Inc., Boise, ID (USA)**	
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AC07-78ID01745	**Mountain States Energy, Inc., Butte, MT (USA)**	
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AC07-79ID01675	**Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)**	
	7:61016	ENICO—1118
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AC08-76NV00410	**Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)**	
	7:61965	CONF-821005—8
AC08-76NV01183	**EG and G, Inc., Las Vegas, NV (USA)**	
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AC08-77CS51518	**Booz, Allen and Hamilton, Inc., Bethesda, MD (USA). Transportation Consulting Div.**	
	7:61747	DOE/CS/51518—1
AC08-78DP40030	**KMS Fusion, Inc., Ann Arbor, MI (USA)**	
	7:61024	KMSF-U—1200
AC08-78DP40045	**Northrop Research and Technology Center, Palos Verdes Peninsula, CA (USA)**	
	7:61885	DOE/DP/40045—1
AC08-81DP40141	**TRW, Inc., Redondo Beach, CA (USA)**	
	7:61886	DOE/DP/40141—1

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AC08-82NV10250	**Westinghouse Electric Corp., Mercury, NV (USA). Advanced Energy Systems Div.**	
	7:60980	DOE/NV/10250—3
AC08-82NV10253	**Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)**	
	7:60981	DOE/NV/10253—1
AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	7:60934	GJBX—204-82
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	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
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AC11-76PN00292	**Duquesne Light Co., Shippingport, PA (USA)**	
	7:61315	DLCS—5000282
AC13-76GJ01664	**Bendix Field Engineering Corp., Grand Junction, CO (USA)**	
	7:60916	GJBX—15-82
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	Geological Services of Tulsa, Inc., OK (USA)	
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	Wichita State Univ., KS (USA)	
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	Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations	
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AC21-75ET08002	Pennzoil Co., Bradford, PA (USA)	
	7:60848	DOE/ET/08002—26
AC21-76ET10666	Fairchild Industries, Inc., Manhattan Beach, CA (USA)	
	7:60720	DOE/ET/10666—T10
AC21-76ET12040	Kentucky Geological Survey, Lexington (USA). Dept. of Geology	
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AC21-76MC10190	Dravo Corp., Pittsburgh, PA (USA). Synthetic Fuels Dept.	
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AC21-78ET11338	West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering	
	7:60721	DOE/ET/11338—1216
AC21-79ET15490	General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.	
	7:61240	DOE/ET/15490—T14
AC21-80MC14380	Brigham Young Univ., Provo, UT (USA)	
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AC21-81FE15067	Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.	
	7:61241	DOE/FE/15067—3
AC21-81MC16477	Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering	
	7:60734	DOE/MC/16477—T4
AC22-77ET10131	UOP, Inc., Des Plaines, IL (USA)	
	7:60717	DOE/ET/10131—T7
AC22-79ET14880	Delaware Univ., Newark (USA). Center for Catalytic Science and Technology	
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AC22-80PC30018	Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group	
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AI01-76ET20319	Kansas State Univ., Manhattan (USA)	
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AI01-76ET20356	Jet Propulsion Lab., Pasadena, CA (USA)	
	7:61064	DOE/JPL—1012-74
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AI01-77ET10350	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
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AI08-76DP00474	Geological Survey, Denver, CO (USA)	
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AI13-81GJ01701	Geological Survey, Denver, CO (USA)	
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AI97-81ET46633	Pennsylvania State Univ., University Park (USA). Materials Research Lab.	
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AM03-76SF00326	Stanford Univ. Medical Center, CA	
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AS04-77EV03972	New Mexico Univ., Albuquerque (USA). Dept. of Radiology	
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AS04-79ET27017	Univ. of New Mexico, Albuquerque	
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AS05-76ER01797	Florida State Univ., Tallahassee (USA). Dept. of Chemistry	
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AS05-76ER02968	Tennessee Univ., Knoxville (USA). Dept. of Chemistry	
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AS05-76ER03346	Georgia Inst. of Tech., Atlanta (USA). School of Chemistry	
	7:62327	DOE/ER/03346—250
AS05-76ER03509	Florida State Univ., Tallahassee (USA). Dept. of Physics	
	7:62273	DOE/ER/03509—18
AS05-76ER05226	Texas A and M Univ., College Station (USA). Dept. of Chemistry	
	7:61850	DOE/ER/05226—1
AS05-76ET28368	Texas Univ., Austin (USA). Electrical Engineering Research Lab.	
	7:62191	DOE/ET/28368—T1
AS05-76ET52023	Virginia Univ., Charlottesville (USA)	
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AS05-76ET53045	College of William and Mary, Williamsburg, VA (USA)	
	7:62402	DOE/ET/53045—6
AS05-76EV03018	Louisiana State Univ., Baton Rouge (USA). Dept. of Chemistry	
	7:61851	DOE/EV/03018—T6
	Louisiana State Univ., Baton Rouge (USA)	
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AS05-77ET28341	Texas Univ., Austin (USA). Electrical Engineering Research Lab.	
	7:62190	DOE/ET/28341—T1
AS05-80ER10618	Vanderbilt Univ., Nashville, TN (USA)	
	7:62234	DOE/ER/10618—7
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AS05-80ER10698	North Carolina State Univ., Raleigh (USA)	
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AS05-80EV10343	Vanderbilt Univ., Nashville, TN (USA). School of Medicine	
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AS05-80EV10363	Tennessee Univ., Knoxville (USA). Dept. of Chemistry	
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AS07-77ET28407	Idaho Dept. of Water Resources, Boise (USA)	
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AS08-77DP04515	Pennsylvania State Univ., University Park (USA). Inst. for Research on Land and Water Resources	
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AS19-80BC10298	Oklahoma State Univ., Stillwater	
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AT03-76ET51011	General Atomic Co., San Diego, CA (USA)	
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AT03-76SF71023	General Atomic Co., San Diego, CA (USA)	
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AT06-76EV70018	Washington Univ., Seattle (USA). Lab. of Radiation Ecology	
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AT06-79RL10120	Washington Univ., Seattle (USA)	
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EG-77-C-07-1735	Idaho Univ., Moscow (USA). Water Resources Research Inst.	
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FC02-78CS35050	Lakeshore Technical Inst., Cleveland, WI (USA)	
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FC02-80CS30382	Wisconsin Univ., Milwaukee (USA). Energy and Buildings Research Inst.	
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FC07-79ID12033	**Montana Bureau of Mines and Geology, Butte (USA)**	
	7:61166	DOE/ID/12033—T1
FC07-79RA23211	**F.W.E. Stapenhorst, Inc., Pointe Claire, Quebec (Canada)**	
	7:61044	DOE/RA—23211
FC20-79LC10036	**Occidental Oil Shale, Inc., Grand Junction, CO (USA)**	
	7:60885	DOE/LC/10036—T11
FC21-80MC14400	**TRW, Inc., Redondo Beach, CA (USA)**	
	7:60733	DOE/MC/14400—06
FG01-77ET10639	**Wisconsin Univ., Milwaukee (USA). Coll. of Engineering and Applied Science**	
	7:60719	DOE/ET/10639—T1
FG01-79CS30013	**Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center**	
	7:61053	DOE/CS/30013—U10
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FG01-80CS15013	**Oregon State Univ., Corvallis**	
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FG01-81FE16116	**Illinois Univ., Chicago (USA). Energy Resources Center**	
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FG01-81RA50393	**Hampshire Energy, Milwaukee, WI (USA)**	
	7:60750	DOE/RA/50393—1241
FG02-80R510242	**Kohring (Gene W.), Hamilton, OH (USA)**	
	7:61215	DOE/R5/10242—T1
FG02-80R510251	**Theisen (Phillip), Madison, WI (USA)**	
	7:61724	DOE/R5/10251—T1
FG03-77ET28425	**Burbank City Public Service Dept., CA (USA)**	
	7:61190	DOE/ET/28425—T1
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1693	NTIS, PC A02/MF A01			7:61755
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339	*See* AD-A-112505/3			7:60855
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88/ 80	NTIS (US Sales Only), MF A0107/MF A01	DE82702668	MN -78	7:61442
CONF-7808107-	(1978 DUMAD summer workshop, San Diego, CA, USA, 11 Aug 1978)			
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CONF-7808138-	(7. course of the international school disarmament and research on conflicts, Ariccia, Italy, 18 Aug 1978,-27 Aug 1927)			
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CONF-7811203-	(International seminar on isochronous cyclotron technique, Cracow, Poland, 13-18 Nov 1978)			
	See INP-1069/PL	DE82780744	MN -48	7:62125
CONF-7904192-	(Technical committee meeting on the procedures of operating nuclear power plants and handling of decontamination wastes, Mol, Belgium, 23-27 Apr 1979)			
(Summ.)	*See* IAEA-TECDOC-248	DE82702469	MN -41	7:61503
CONF-7906244-	(NATO Advanced Study Institute conference on mathematical modelling of energy systems, Istanbul, Turkey, 9-23 Jun 1979)			
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CONF-790807-	(Topical conference on reactor operating experience, Arlington, TX, USA, 5-8 Aug 1979)			
	Trans. Am. Nucl. Soc., Suppl., 32: 30-31(1979)			7:60951
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	Trans. Am. Nucl. Soc., Suppl., 32: 30(1979)			7:61471
CONF-791205-	(ASME winter annual meeting, New York, NY, USA, 2-7 Dec 1979)			
	Am. Soc. Mech. Eng., [Pap.], No. 79-WA/TS-6, 1-8(1979)			7:61744
CONF-791231-	(17. General Assembly of the International Union of Geodesy and Geophysics, Canberra, Australia, Dec 1979)			
Exc.	Kluwer Boston Inc., 190 Old Derby Street, Hingham, MA 02043			7:62231
CONF-8003106-	(Symposium on the biological risks of medical irradiations, San Antonio, TX, USA, 26-28 Mar 1980)			
	American Institute of Physics, 335 East 45 Street, New York, NY 10017, $21.00			7:62140
CONF-8010218-3	(Meeting on fission, L'Alpe d'Huez, France, 6-10 Oct 1980)			
	See BLG-539	DE82902859	MN -34C	7:62329
CONF-801107-	(ANS international conference, Washington, DC, USA, 17-21 Nov 1980)			
	Trans. Am. Nucl. Soc., 35: 120-122(1980)			7:60961
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	Trans. Am. Nucl. Soc., 35: 123-124(1980)			7:62535
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CONF-8011170-	(FAO/IAEA conference on improvement of oil-seed and industrial crops by induced mutations, Vienna, Austria, 17-21 Nov 1980)			
	See STI/PUB-608		ND -48	7:62083
CONF-801291-1	(4. congress of limnology and oceanography, Chiavari, Italy, 1-3 Dec 1980)			
	See CISE-1635	DE82902845	MN -11	7:62195
CONF-810176-	(Meeting of experts of Annex III and IIIa integration of wind power into national electricity supply systems, Regensburg, F.R. Germany, 29-30 Jan 1981)			
	See Juel-Spez-108	DE82902575	MN -60	7:61223
CONF-810373-	(5. international conference on fracture, Cannes, France, 29 Mar-3 Apr 1981)			
	See CISE-1693			7:61755
CONF-8103113-	(Western tight gas sands advanced logging workshop, Tulsa, OK, USA, 17-18 Mar 1981)			
	NTIS, PC A12/MF A01	DE82014589	STD -92a	7:60867
CONF-8104171-	(2. annual Gulf of Mexico information transfer meeting, New Orleans, LA, USA, 30 Apr-1 May 1981)			
Abstr.	NTIS, PC A06/MF A01	DE82906198	MN -11	7:60860
CONF-8104175-	(Joint Canadian/Mexico symposium on comparative and joint politics of energy, Boston, MA, USA, 9-10 Apr 1981)			
Summ.	Univ. Consortium for Research on North America, 1737 Cambridge St., Cambridge, MA 02138, $3.25			7:61615
CONF-810511-	(Workshop on ambipolar potential formation and control in bumpy tori and mirrors, Oak Ridge, TN, USA, 11-12 May 1981)			
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CONF-810538-	(Spring AIIE conference, Detroit, MI, USA, 17-20 May 1981)			
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CONF-810573-	(International conference on defects in insulating crystals, Riga-Salaspils, USSR, 18-23 May 1981)			
2	*See* LAFI-028	DE82702604	MN -34A	7:61787
3	*See* LAFI-030	DE82702605	MN -34A	7:61788
4	*See* LAFI-035	DE82702606	MN -34A	7:61789
5	*See* LAFI-036	DE82702607	MN -34A	7:61790
6	*See* LAFI-038	DE82702608	MN -34A	7:61791
7	*See* LAFI-041	DE82702609	MN -34A	7:61792
8	*See* LAFI-042	DE82702610	MN -34A	7:61793
CONF-8105130-	(Symposium on effects on humans of exposure to low levels of ionizing radiation, New Haven, CT, USA, 11-17 May 1981)			
1-Rev.	*See* LBL-13416-Rev.	DE82022058	MN -48	7:62127
CONF-810606-	(American Nuclear Society's annual meeting, Miami Beach, FL, USA, 7-12 Jun 1981)			
	Trans. Am. Nucl. Soc., 38: 621-622(1981)			7:61009
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CONF-810673-	(4. symposium on neutron dosimetry, Munich-Neuherberg, F.R. Germany, 1-5 Jun 1981)			
6	*See* CEA-CONF-6026	DE82702675	MN -80	7:61479
CONF-8106200-	(21. annual international conference on Canadian Nuclear Association and 2. annual conference on Canadian Nuclear Society, Ottawa, Canada, 8-10 Jun 1981)			
3	*See* AECL-7437	DE82905976	MN -70	7:60968
4	*See* AECL-7338	DE82905977	MN -70	7:60967
5	*See* AECL-7439	DE82905975	MN -70	7:60969
6	*See* AECL-7337	DE82905978	MN -70	7:60966
CONF-8106214-	(Conference on the first detection of carbon dioxide effects, Harpers Ferry, WV, USA, 8-10 Jun 1981)			
	NTIS, PC A24/MF A01	DE82016633	STD -11	7:61968
CONF-8106243-	(Workshop on high intensity accelerators and compressor rings, Karlsruhe, F.R. Germany, 25-26 Jun 1981)			
	See KFK-3228	DE82780742	MN -28	7:61911
CONF-810754-	(12. IPEAC international conference on the physics of electronics and atomic collisions, Gatlinburg, TN, USA, 15-22 Jul 1981)			
4	NTIS, PC A02/MF A01	DE82018263	MN -20g	7:62392

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CONF-810801-	(6. international conference on structural mechanics in reactor technology, Paris, France, 17-21 Aug 1981)			
92	NTIS, PC A02/MF A01	DE82020939	MN -80	7:61443
CONF-810809-	(16. international conference on low temperature physics, Los Angeles, CA, USA, 19-25 Aug 1981)			
28	NTIS, PC A02/MF A01	DE82020890	MN -34C	7:61785
CONF-810831-	(Fusion reactor materials meeting, Seattle, WA, USA, 9-12 Aug 1981)			
95	NTIS, PC A02/MF A01	DE82020906	MN -20c	7:61782
96	NTIS, PC A02/MF A01	DE82020920	MN -20c	7:62393
97	NTIS, PC A02/MF A01	DE82020902	MN -20c	7:62468
98-Draft	NTIS, PC A02/MF A01	DE82020938	MN -20c	7:61756
CONF-810842-	(American Statistical Association meeting, Detroit, MI, USA, 10-13 Aug 1981)			
6	NTIS, PC A02/MF A01	DE82020918	MN -22	7:62376
7	NTIS, PC A02/MF A01	DE82020901	MN -32	7:61603
CONF-810851-	(4. international conference on rapidly quenched metals, Sendai, Japan, 24-28 Aug 1981)			
5	NTIS, PC A02/MF A01	DE82020934	MN -25	7:62365
CONF-810856-	(International conference on the science of hard materials, Moran, WY, USA, 23-28 Aug 1981)			
5	NTIS, PC A02/MF A01	DE82020915	MN -25	7:61757
CONF-8108135-	(IPA workshop on modeling the fate of chemicals in the aquatic environment, Pellston, MI, USA, 17-21 Aug 1981)			
1	NTIS, PC A03/MF A01	DE82020937	MN -11	7:62034
CONF-8108137-	(National workshop on in-place resource inventories: principles and practices, Orono, ME, USA, 9-14 Aug 1981)			
1	NTIS, PC A02/MF A01	DE82020903	MN -11	7:62016
CONF-8108138-	(Symposium on geodetic networks and computations, Munich, F.R. Germany, 30 Aug-4 Sep 1981)			
1	NTIS, PC A02/MF A01	DE82020905	MN -32	7:62543
CONF-8108139-	(Conference on analytical goals in clinical enzymology, Aspen, CO, USA, 18-20 Aug 1981)			
1-Draft	NTIS, PC A02/MF A01	DE82020913	MN -48	7:61827
CONF-810946-	(Conference on advancement in heat exchangers, Dubrovnik, Yugoslavia, 7-12 Sep 1981)			
	See AECL-7165	DE82702481	MN -80	7:61335
CONF-811007-	(2. world congress of chemical engineering, Montreal, Canada, 4-9 Oct 1981)			
	See AECL-7429	DE82780745	MN -22	7:61639
CONF-811043-	(5. biennial wind energy conference and workshop, Washington, DC, USA, 5-8 Oct 1981)			
	See NASA-TM-82761			7:61229
CONF-811056-	(Seminar on the management of radioactive waste from nuclear power plants, Karlsruhe, F.R. Germany, 5-9 Oct 1981)			
9	*See* AECL-7522	DE82905979	MN -70	7:60970
CONF-8110148-	(CSNI specialist meeting on operator training and qualifications, Charlotte, NC, USA, 12-15 Oct 1981)			
Vol.1	*See* NUREG/CP-0031-Vol.1		MN -80	7:61267
Vol.2	*See* NUREG/CP-0031-Vol.2		MN -80	7:61278
CONF-8110182-	(4. international conference on lasers and their applications, Leipzig, German Democratic Republic, 19-23 Oct 1981)			
	See INIS-mf-7048	DE82780692	MN -2	7:61887
CONF-8110215-	(9. annual Illinois energy conference - Illinois energy policy: new directions for the eighties, Chicago, IL, USA, 28-30 Oct 1981)			
	NTIS, PC A08/MF A01	DE82018954	MN -13	7:61643
CONF-811101-	(Winter annual meeting of the ASME Technology and Society Division, Washington, DC, USA, 15-20 Nov 1981)			
30	*See* UCRL-85833	DE82019109	MN -38	7:61879
CONF-811103-	(ANS winter meeting, San Francisco, CA, USA, 29 Nov-4 Dec 1981)			
	Trans. Am. Nucl. Soc., 39: 973-974(1981)			7:60960
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CONF-811113-	(American Vacuum Society national symposium, Anaheim, CA, USA, 3-6 Nov 1981)			
56	*See* UCRL-86113	DE82019114	MN -21	7:61025
CONF-811223-	(Workshop on meteorological aspects of emergency response plans for nuclear power plants, Menlo Park, CA, USA, 1-3 Dec 1981)			
Summ.	*See* NUREG/CP-0032		MN -80	7:61530
CONF-811249-	(Conference on legal aspects of geothermal development, Newport Beach, CA, USA, 3-4 Dec 1981)			
	Geothermal Resources Council, P.O. Box 98, Davis, CA 95617		MN -66h	7:61172
CONF-811253-	(Silver jubilee physics symposium, Bombay, India, 28 Dec 1981,-1 Jan 1982)			
Pt.1	NTIS (US Sales Only), MF A01	DE82905330	MN -34	7:62304
Pt.2	NTIS (US Sales Only), MF A01	DE82905331	MN -34	7:62366
CONF-811254-	(All-union conference on low and middle ions accelerators, Kiev, Ukrainian SSR, 1-2 Dec 1981)			
1	*See* JINR-R-9-81-711	DE82702660	MN -28	7:61918
CONF-820208-	(2. annual contractors meeting on gas stream clean up, Morgantown, WV, USA, 17-19 Feb 1982)			
	See DOE/METC-82-47	DE82018281	STD -90c	7:60774
CONF-820378-	(Gas Research Institute workshop on vapor dispersion, Cambridge, MA, USA, 23 Mar 1982)			
1	*See* UCRL-87668	DE82015922	MN -11	7:60879
CONF-820390-	(13. spring symposium on high energy physics, Bad Schandau, F.R. Germany, 23-28 Mar 1982)			
1	*See* NBI-HE-82-8	DE82702690	MN -34D	7:62299
CONF-820420-	(International ENS/ANS conference on nuclear energy with emphasis on fuel cycles, Brussels, Belgium, 26-30 Apr 1982)			
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	Trans. Am. Nucl. Soc., 40: 59-63(1982)			7:61008
CONF-820424-	(ANS topical meeting on treatment and handling of radioactive wastes, Richland, WA, USA, 19-22 Apr 1982)			
33	*See* BNL-31650	DE82020024	MN -70	7:60971
CONF-820435-	(CLEOS conference, Phoenix, AZ, USA, 14 Apr 1982)			
3	*See* UCRL-87059	DE82020170	MN -21	7:62499
4	*See* UCRL-86910	DE82020177	MN -21	7:62498
CONF-820508-	(Spring meeting of the Electrochemical Society, Montreal, Canada, 9-14 May 1982)			
4	*See* SERI/TP-213-1618	DE82020507	MN -63b	7:61089
CONF-820510-	(Spring meeting for the Society for the Advancement of Materials and Process Engineering, San Diego, CA, USA, 4-6 May 1982)			
5	*See* SAND-82-8817	DE82021705	MN -90e	7:60837
CONF-820515-	(Spring DECUS symposium, Atlanta, GA, USA, 10-14 May 1982)			
8	*See* EGG-1183-1841	DE82021366	MN -32	7:62546
CONF-820547-	(84. annual meeting of the American Ceramic Society, Cincinnati, OH, USA, 2-5 May 1982)			
14	*See* HEDL-SA-2674-FP	DE82016157	MN -20d	7:62478
CONF-820550-	(Geological Society of American Rocky Mountain section meeting, Bozeman, MT, USA, 7-8 May 1982)			
4	*See* RHO-BW-SA-190	DE82015795	MN -70	7:61000
CONF-820561-	(4. workshop on distributed computer control systems, Tallinn, USSR, 24-26 May 1982)			
2	*See* UCRL-86827	DE82015909	MN -32	7:62497
CONF-820566-	(Thermal reactor benchmark calculations, techniques, results and applications seminar, Upton, NY, USA, 17-18 May 1982)			
7	*See* LA-UR-82-2341	DE82021772	MN -34C	7:61302

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CONF-8205106-	(American Welding Society conference, Atlanta, GA, USA, 18-20 May 1982)			
1	*See* UCRL-87639	DE82016841	MN -38	7:61898
CONF-8205108-	(UBC-UM conference on the milky-way, Vancouver, BC, Canada, 17-19 May 1982)			
1	*See* UCRL-87815	DE82019063	MN -34B	7:62209
CONF-8205115-	(Advanced seminar on the theory of dispersed multiphase flow, Madison, WI, USA, 26-28 May 1982)			
1	*See* SAND-82-1291C	DE82019341	MN -38	7:61894
CONF-8205116-	(5. international conference on novel results in particle physics, Nashville, TN, USA, 24-26 May 1982)			
3	*See* LBL-14647	DE82020100	MN -34D	7:62298
CONF-8205122-	(Actinide workshop, Augusta, GA, USA, 11-12 May 1982)			
1	*See* RFP-3359	DE82021618	MN -10	7:61835
CONF-820601-	(ASME pressure vessel and piping conference, Orlando, FL, USA, 27 Jun-1 Jul 1982)			
10	*See* HEDL-SA-2595	DE82016263	MN -79k	7:61346
CONF-820609-	(American Nuclear Society annual meeting, Los Angeles, CA, USA, 6-11 Jun 1982)			
	Trans. Am. Nucl. Soc., 41: 4(Jun 1982)			7:60758
	Trans. Am. Nucl. Soc., 41: 5(Jun 1982)			7:60759
	Trans. Am. Nucl. Soc., 41: 6(Jun 1982)			7:60760
	Trans. Am. Nucl. Soc., 41: 7(Jun 1982)			7:60761
35	*See* DPSPU-82-30-4	DE82016268	MN -46	7:60953
CONF-820612-	(Symposium on instrumentation and control for fossil energy processes, Houston, TX, USA, 7-9 Jun 1982)			
10	NTIS MF A01	DE82017400	MN -90g	7:61673
CONF-820635-	(International conference on hypernuclear and kaon physics, Heidelberg, F.R. Germany, 20-24 Jun 1982)			
6	*See* DOE/ER/03244-98	DE82021914	MN -34D	7:62272
CONF-820646-	(International Energy Agency Annex 1 workshop on thermochemical hydrogen, San Diego, CA, USA, 22-24 Jun 1982)			
1	*See* UCRL-87706	DE82016252	MN -20d	7:61026
CONF-820655-	(Health Physics Society annual meeting, Las Vegas, NV, USA, 27 Jun-1 Jul 1982)			
9	*See* LBL-14772	DE82022068	MN -48	7:62128
CONF-820675-	(International conference on neutrino physics, Balaton, Hungary, 14-19 Jun 1982)			
3	*See* DOE/ER/40033-27	DE82022009	MN -34C	7:62275
CONF-8206101-	(Conference on pulsations in classical and cataclysmic variable stars, Boulder, CO, USA, 1 Jun 1982)			
3	*See* LA-UR-82-2304	DE82021925	MN -34B	7:62204
4	*See* LA-UR-82-2302	DE82021924	MN -34B	7:62203
8	*See* LA-UR-82-2347	DE82021775	MN -34B	7:62205
CONF-8206111-	(Symposium on relativistic effects in quantum chemistry, Abo Akademi, Finland, 21-23 Jun 1982)			
1	*See* LBL-14705	DE82020541	MN -4	7:61853
CONF-8206112-	(Conference on symmetries and properties of non-rigid molecules, Paris, France, 30 Jun-8 Jul 1982)			
1	*See* LBL-14598	DE82020518	MN -4	7:61852
CONF-8206113-	(IAEA meeting on advances in dosimetry for fast neutrons and heavy charged-particles for therapy applications, Vienna, Austria, 14-18 Jun 1982)			
1	*See* LBL-14779	DE82020315	MN -48	7:62361
CONF-8206115-	(6. Canadian fracture conference on time dependent fracture of engineering materials - environmental effects, Harrison Hot Springs, B.C, Canada, 17-18 Jun 1982)			
1	*See* BNL-31776	DE82021543	MN -25	7:61754
CONF-820704-	(International topical meeting on LMFBR safety, Lyon, France, 18-23 Jul 1982)			
27	*See* BNL-NUREG-31679		MN -79p	7:61498
CONF-820708-	(IEEE annual conference on nuclear and space radiation effect, Las Vegas, NV, USA, 20-22 Jul 1982)			
9	*See* SAND-82-0780C	DE82020982	MN -25	7:61810
CONF-820717-	(PAHR information exchange conference, Karlsruhe, F.R. Germany, 28-30 Jul 1982)			
2	*See* BNL-NUREG-31763		MN -80	7:61499
CONF-820747-	(Accreting neutron star conference, Garching, F.R. Germany, 1 Jul 1982)			
1	*See* LA-UR-82-2461	DE82021896	MN -34B	7:62206
CONF-820748-	(Workshop on accreting neutron stars, Munchen, F.R. Germany, 18-23 Jul 1982)			
1	*See* LA-UR-82-2558	DE82022013	MN -34B	7:62207
CONF-820749-	(14. conference of the European Group for Atomic Spectroscopy, Liege, Belgium, 27-30 Jul 1982)			
1	*See* DOE/ER/10618-7	DE82021831	MN -34A	7:62234
CONF-820802-	(International meeting on thermal nuclear reactor safety, Chicago, IL, USA, 29 Aug-2 Sep 1982)			
7	*See* SAND-82-1923C	DE82020441	MN -80	7:61554
16	*See* SAND-82-0450C	DE82022004	MN -78	7:61551
17	*See* SAND-82-0441C	DE82022005	MN -78	7:61550
19	*See* LA-UR-82-2429	DE82021891	MN -78	7:61521
20	*See* LA-UR-82-2498	DE82021762	MN -78	7:61522
21	*See* SAND-82-0383C	DE82021870	MN -78	7:61549

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CONF-820803-	(23. US symposium on rock mechanics, Berkeley, CA, USA, 25-27 Aug 1982)			
14	*See* RHO-BW-SA-201-P	DE82021718	MN -70	7:62196
CONF-820807-	(16. annual meeting of the Microbeam Analysis Society, Washington, DC, USA, 9-13 Aug 1982)			
4	NTIS, PC A02/MF A01	DE82020912	MN -25	7:61950
CONF-820808-	(6. international conference on the strength of metals and alloys, Melbourne, Australia, 16-20 Aug 1982)			
2	NTIS, PC A02/MF A01	DE82020914	MN -25	7:61758
3	NTIS, PC A02/MF A01	DE82020899	MN -25	7:61759
CONF-820810-	(10. international mathematics and computers simulation congress on systems simulation and scientific computation, Montreal, Canada, 9-13 Aug 1982)			
12	NTIS, PC A02/MF A01	DE82020910	MN -32	7:62542
CONF-820814-	(17. Intersociety Energy Conversion Engineering conference, Los Angeles, CA, USA, 8-13 Aug 1982)			
29	*See* BNL-31666	DE82021744	MN -94d	7:61034
CONF-820820-	(Review of progress in quantitative NDE, San Diego, CA, USA, 1-6 Aug 1982)			
1	*See* UCRL-87785	DE82019317	MN -11	7:62193
3	*See* UCRL-87601	DE82021927	MN -25	7:61802
CONF-820822-	(26. technical symposium and exhibition of the International Society for Optical Engineering, San Diego, CA, USA, 21-27 Aug 1982)			
9	*See* UCRL-87158	DE82020848	MN -21	7:62500
10	*See* LA-UR-82-2391	DE82021882	MN -21	7:62485
11	*See* LA-UR-82-2476	DE82021898	MN -37	7:61952
CONF-820827-	(Energy storage contractors review meeting, Arlington, VA, USA, 23-26 Aug 1982)			
3	*See* SERI/TP-234-1681	DE82020069	MN -62	7:61090
11	NTIS, PC A02/MF A01	DE82020807	MN -94a	7:61587
18	*See* BNL-31724	DE82021745	MN -94c	7:61035
21	*See* SERI/TP-252-1691	DE82020989	MN -62	7:61157
22	*See* SERI/TP-252-1685	DE82020981	MN -62	7:61156
CONF-820828-	(9. EPS Nuclear Physics Divisional conference on nuclear structure, Amsterdam, Netherlands, 29 Aug-4 Sep 1982)			
4	*See* SAND-82-0787C	DE82020407	MN -34	7:61811
CONF-820833-	(17. DOE nuclear air cleaning conference, Denver, CO, USA, 1 Aug-6 Sep 1982)			
9	*See* SAND-82-1812C	DE82020290	MN -78	7:61553
CONF-820842-	(20. DOE seminar on explosive safety, Norfolk, VA, USA, 24-26 Aug 1982)			
1	*See* SAND-82-1816C	DE82019485	MN -45	7:61962
CONF-820846-	(10. international congress on electron microscopy, Hamburg, F.R. Germany, 17-24 Aug 1982)			
2	NTIS, PC A02/MF A01	DE82020931	MN -25	7:61760
CONF-820847-	(International Users Group conference on HP 1000, Long Beach, CA, USA, 30 Aug-9 Sep 1982)			
1	*See* UCRL-87612	DE82020344	MN -32	7:62559
CONF-820849-	(Summer study in energy efficient buildings, Santa Cruz, CA, USA, 22-28 Aug 1982)			
3	*See* BNL-31765	DE82021753	MN -95d	7:61686
5	*See* LBL-14733	DE82020978	MN -95d	7:61698
7	*See* LBL-14735	DE82022055	MN -95d	7:61699
CONF-820850-	(Society for Applied Spectroscopy and Rocky Mountain Chromatography Group conference, Denver, CO, USA, 1-5 Aug 1982)			
1	*See* BDX-613-2825	DE82020342	MN -38	7:61803
CONF-820853-	(NATO conference on photophysics and photochemistry in the vacuum ultraviolet, Lake Geneva, WI, USA, 15-29 Aug 1982)			
2	NTIS, PC A02/MF A01	DE82020822	MN -34A	7:62232
CONF-820854-	(4. annual DOE LLWMP participant's information meeting, Denver, CO, USA, 31 Aug-2 Sep 1982)			
3	*See* LA-UR-82-2535	DE82021802	MN -70	7:60993
4	*See* LA-UR-82-2533	DE82022018	MN -70	7:60991
5	*See* LA-UR-82-2534	DE82022017	MN -70A	7:60992
6	*See* LA-UR-82-2532	DE82022019	MN -70	7:60990
7	*See* BNL-NUREG-31826		MN -70	7:60973
8	*See* BNL-NUREG-31833		MN -70	7:60975
9	*See* BNL-NUREG-31827		MN -70	7:60974
11	NTIS, PC A02/MF A01	DE82022339	MN -70	7:60976
12	*See* BNL-NUREG-31834		MN -70B	7:61014
CONF-820858-	(Technical Association of Pulp and Paper Industries conference, Asheville, NC, USA, 30 Aug-1 Sep 1982)			
1	NTIS, PC A02/MF A01	DE82020813	MN -13	7:62109
CONF-820862-	(Utilities operations seminar, Amarillo, TX, USA, 3-5 Aug 1982)			
1	*See* BDX-613-2827	DE82905966	MN -38	7:61685
CONF-820866-	(7. international conference on gas discharges and their applications, London, UK, 31 Aug-3 Sep 1982)			
2	NTIS, PC A02/MF A01	DE82020898	MN -34A	7:62233
CONF-820867-	(17. European peptide symposium, Prague, Czechoslovakia, 24 Aug-2 Sep 1982)			
1	*See* BNL-31805	DE82022053	MN -48	7:62057

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CONF-820868-	(International conference on atomic physics, Gothenburg, Sweden, 2-6 Aug 1982)			
1	*See* DOE/ER/10618-8	DE82021632	MN -34A	7:62235
CONF-820909-	(National meeting of the American Chemical Society, Kansas City, MO, USA, 1 Sep 1982)			
9	*See* MLM-2992-OP	DE82021348	MN -22	7:61854
CONF-820926-	(Marine Technology Society and Geological Society of America conference on oceans, Washington, DC, USA, 20-22 Sep 1982)			
4	*See* LBL-14799	DE82020979	MN -64	7:61123
CONF-820928-	(International passive and low-energy alternatives conference, Bermuda, Bermuda, 5-15 Sep 1982)			
1	*See* SERI/TP-254-1652	DE82019255	MN -59c	7:61707
2	*See* SERI/TP-254-1653	DE82018194	MN -59c	7:61047
3	*See* SERI/TP-254-1673	DE82022038	MN -59a	7:61708
CONF-820929-	(IUPAP international conference on magnetism, Kyoto, Japan, 6-10 Sep 1982)			
4	*See* BNL-31791	DE82021566	MN -25	7:61784
CONF-820930-	(9. international conference on plasma physics and controlled nulcear fusion research, Baltimore, MD, USA, 1-8 Sep 1982)			
6	*See* KMSF-U-1200	DE82020737	MN -21	7:61024
10	*See* UCRL-87948	DE82020352	MN -20b	7:62423
10-Rev.1	*See* UCRL-87948-Rev.1	DE82020850	MN -20g	7:62424
12	*See* LA-UR-82-2531	DE82022020	MN -20f	7:62486
13	*See* LA-UR-82-2340	DE82021771	MN -20g	7:62408
14	*See* LA-UR-82-2543	DE82022014	MN -20f	7:62411
17	NTIS, PC A02/MF A01	DE82022261	MN -20f	7:62394
CONF-820931-	(8. symposium on microdosimetry, Julich, F.R. Germany, 27 Sep-1 Oct 1982)			
2	*See* LA-UR-82-2460	DE82021895	MN -48	7:62126
4	*See* BNL-31778	DE82021560	MN -48	7:62114
5	*See* BNL-31777	DE82022048	MN -41	7:62360
6	NTIS, PC A02/MF A01	DE82022287	MN -41	7:62342
7	NTIS, PC A02/MF A01	DE82022288	MN -41	7:62343
CONF-820933-	(International conference on radioactive waste management, Winnipeg, Manitoba, Canada, 12-15 Sep 1982)			
3	*See* UCRL-87248	DE82021351	MN -85	7:61007
4	NTIS, PC A02/MF A01	DE82022244	MN -70	7:60977
CONF-820935-	(6. Yamada conference on neutron scattering of condensed matter, Tokyo, Japan, 1 Sep 1982)			
2	*See* BNL-31722	DE82020027	MN -34C	7:61783
CONF-820937-	(16. international conference on the physics of semiconductors, Montpellier, France, 6-10 Sep 1982)			
2	*See* LBL-14755	DE82019739	MN -25	7:61807
CONF-820940-	(Passive and hybrid solar energy update conference, Washington, DC, USA, 15-17 Sep 1982)			
1	*See* LA-UR-82-2497	DE82021761	MN -59a	7:61131
CONF-820942-	(Nuclear data for science and technology international conference, Antwerp, Belgium, 6-10 Sep 1982)			
3	*See* LA-UR-82-2529	DE82022021	MN -34C	7:62410
4	*See* LA-UR-82-2456	DE82021894	MN -34C	7:62324
6	NTIS, PC A02/MF A01	DE82022340	MN -34C	7:62319
7	NTIS, PC A02/MF A01	DE82022341	MN -34C	7:62344
8	NTIS, PC A02/MF A01	DE82022342	MN -34C	7:62345
CONF-820944-	(Workshop on diagnostics for fusion reactor conditions, Varenna, Italy, 6-17 Sep 1982)			
1	*See* LA-UR-82-2466	DE82021897	MN -20f	7:62409
2	*See* UCRL-87675	DE82021117	MN -20f	7:62422
5	NTIS, PC A03/MF A01	DE82022242	MN -20f	7:62395
CONF-820945-	(International conference on ion beam modification of materials, Grenoble, France, 6-10 Sep 1982)			
1	*See* SAND-82-0773C	DE82021871	MN -25	7:61796
CONF-820946-	(4. annual electrical overstress/electrostatic discharge symposium, Orlando, FL, USA, 21-23 Sep 1982)			
1	*See* UCRL-87400	DE82020965	MN -38	7:62372
CONF-820948-	(12. symposium on fusion technology, Juelich, F.R. Germany, 13-17 Sep 1982)			
2	*See* UCRL-87532	DE82021616	MN -21	7:62502
CONF-820950-	(Conference on the neutron and its applications, Cambridge, UK, 13-17 Sep 1982)			
1	*See* BNL-31793	DE82021568	MN -34C	7:62341
CONF-821002-	(3. international conference on distributed computing systems, Miami, FL, USA, 18-22 Oct 1982)			
1	*See* UCRL-87414	DE82012260	MN -32	7:62557
CONF-821003-	(Conference on advances and trends in structural and solid mechanics, Washington, DC, USA, 4-7 Oct 1982)			
1	*See* UCRL-86739	DE82012701	MN -38	7:61880
CONF-821005-	(DOE international decommissioning symposium, Seattle, WA, USA, 10-14 Oct 1982)			
8	NTIS, PC A02/MF A01	DE82020396	MN -70A	7:61965
10	*See* LA-UR-82-2372	DE82021879	MN -70	7:60989
CONF-821006-	(7. conference on local computer networks, Minneapolis, MN, USA, 12-13 Oct 1982)			
1	*See* UCRL-87473	DE82015192	MN -32	7:62558
3	*See* UCRL-87759	DE82019107	MN -32	7:62560

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CONF-821012-	(Institute for management sciences/Operations research Society of America joint meeting, San Diego, CA, USA, 25-27 Oct 1982)			
1	*See* UCRL-86218	DE82016778	MN -15	7:61023
CONF-821018-	(American Society of Mechanical Engineers conference on power generation, Denver, CO, USA, 17-21 Oct 1982)			
2	*See* DOE/NASA/10350-34	DE82020329	STD -90d	7:60833
CONF-821024-	(10. international symposium on discharges and electrical insulation in vacuum, Columbia, SC, USA, 25-28 Oct 1982)			
2	*See* SAND-82-0943C	DE82020055	MN -48	7:62092
3	*See* LA-UR-82-2400	DE82021883	MN -28	7:61901
4	*See* BNL-31822	DE82022049	MN -28	7:61933
CONF-821026-	(2. international workshop on the impact of hydrogen on water reactor safety, Albuquerque, NM, USA, 3-7 Oct 1982)			
3	*See* SAND-82-1260C	DE82021724	MN -78	7:61552
CONF-821101-	(ASME winter annual meeting, Pheonix, AZ, USA, 14-19 Nov 1982)			
2	*See* LA-UR-82-1026	DE82014082	MN -78	7:61520
6	*See* SAND-82-1586C	DE82018645	MN -21	7:62494
7	*See* UCRL-87347	DE82019240	MN -20a	7:62501
9	*See* MLM-2962-OP	DE82019322	MN -59c	7:61148
CONF-821103-	(American Nuclear Society winter meeting, Washington, DC, USA, 14-19 Nov 1982)			
2	*See* DOE/ET/52040-245	DE82016825	MN -20	7:62473
3	*See* DOE/ET/52040-244	DE82016818	MN -20	7:62401
8	*See* BNL-NUREG-31430		MN -79p	7:61342
11	*See* BNL-31600	DE82019450	MN -20g	7:62467
13	*See* BNL-NUREG-31620		MN -80	7:61294
16	NTIS, PC A02/MF A01	DE82020203	MN -20d	7:62396
17	NTIS, PC A02/MF A01	DE82020181	MN -20a	7:62397
19	*See* BNL-NUREG-31619		MN -78	7:61314
21	*See* BNL-NUREG-31623		MN -78	7:61497
CONF-821106-	(Annual meeting of heat transfer and energy conversion, Los Angeles, CA, USA, 14-18 Nov 1982)			
4	NTIS, PC A03/MF A01	DE82021544	MN -90a	7:60767
CONF-821107-	(Materials Research Society meeting, Boston, MA, USA, 1-4 Nov 1982)			
2	*See* BNL-NUREG-31390		MN -78	7:61313
CONF-821110-	(3. annual national low-level waste management program meeting, New Orleans, LA, USA, 4-6 Nov 1982)			
3	*See* BNL-31651	DE82020032	MN -70	7:60972
CONF-821111-	(29. national symposium on American Vacuum Society, Baltimore, MD, USA, 16-19 Nov 1982)			
2	*See* UCRL-87735	DE82020728	MN -20	7:62503
CONF-821114-	(American Meteorological Society conference on cloud physics, Chicago, IL, USA, 15-17 Nov 1982)			
1	*See* UCRL-87553	DE82020378	MN -11	7:61999
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1599-219-Pt.1	*See* DOE/EV/01599-219-Pt.1	DE82021861	MN -48	7:62030
1599-219-Pt.4	*See* DOE/EV/01599-219-Pt.4	DE82021971	MN -48	7:62031
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2218-245	*See* DOE/ET/52040-245	DE82016825	MN -20	7:62473
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3244-98	*See* DOE/ER/03244-98	DE82021914	MN -34D	7:62272
3539-20	*See* DOE/ER/03539-20	DE82021049	MN -34D	7:62274
3571-23	*See* DOE/EV/03571-23	DE82021228	MN -48	7:62115
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CRPE-NT-				
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63-Vol.1	*See* NUREG/CP-0031-Vol.1		MN -80	7:61267
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018/ 80	NTIS (US Sales Only), MF A0104/MF A01	DE82702672	MN -79	7:61481
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76-020.80A	NTIS, PC A04/MF A01	DE81028443	STD -90e	7:61238
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81/ 13	NTIS (US Sales Only), MF A0102/MF A01; Also available from Library, Democritus NRC	DE82702537	MN -4	7:61761
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81-056	NTIS (US Sales Only), MF A0102/MF A01	DE82020282	MN -28	7:62281

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DESY-SR-				
81/ 06	NTIS (US Sales Only), MF A0102/MF A01	DE82906229	MN -34A	7:61849
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55E	NTIS (US Sales Only), MF A0102/MF A01	DE82702474	MN -28	7:61934
58E	NTIS (US Sales Only), MF A0103/MF A01	DE82702470	MN -22	7:61027
59E	NTIS (US Sales Only), MF A0102/MF A01	DE82702484	MN -37	7:61935
DLCS-				
5000282	NTIS, PC A02/MF A01	DE82021002	MN -78	7:61315
DOE/ARS-				
3707-20741/ 81/ 1	NTIS, PC A04/MF A01	DE82016270	STD -60	7:61214
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1	NTIS, PC A06/MF A01	DE82021661	STD -92a	7:60713
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82/ 3	NTIS, PC A04/MF A01	DE82021119	STD -92	7:60865
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034	NTIS, PC A04/MF A01	DE82020494	STD -96	7:61033
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3	NTIS, PC A19/MF A01	DE82021055	MN -89	7:60714
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2	NTIS, PC A05/MF A01	DE82020532	MN -59c	7:61124
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T1	NTIS, PC A06/MF A01	DE82013961	STD -63b	7:61061
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T1	NTIS, PC A06/MF A01	DE82020797	MN -95d	7:61687
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T6	NTIS, PC A06/MF A01	DE82020794	MN -95d	7:61692
DOE/CS/22804-				
1-Vol.3	NTIS, PC A08/MF A01	DE82009970	MN -95	7:61636
DOE/CS/24312-				
4	NTIS, PC A03/MF A01	DE82022154	STD -95e	7:61734
DOE/CS/30013-				
U10	NTIS, PC A99/MF A01	DE82020563	STD -98	7:61053
U11	NTIS, PC A07/MF A01	DE82020560	STD -98	7:61054
DOE/CS/30035-				
T2	NTIS, PC A09/MF A01	DE82021001	MN -59c	7:61125
DOE/CS/30382-				
1	NTIS, PC A09/MF A01	DE82020798	MN -59a	7:61126
DOE/CS/35050-				
T1	NTIS, PC A04/MF A01	DE82019277	MN -59	7:61127
DOE/CS/40040-				
5	NTIS, PC A09/MF A01	DE82022029	MN -95f	7:61720
DOE/CS/40191-				
T1	NTIS, PC A17/MF A01	DE82020768	MN -95f	7:61721
DOE/CS/40210-				
T1	NTIS, PC A02/MF A01	DE81011194	MN -95f	7:61722
DOE/CS/40312-				
1	NTIS, PC A04/MF A01	DE82020948	MN -95d	7:61723
DOE/CS/50025-				
2	NTIS, PC A03/MF A01	DE82021022	STD -96	7:61751
DOE/CS/51518-				
1	NTIS, PC A03/MF A01	DE82021006	MN -96	7:61747
DOE/CS/62020-				
T4	NTIS, PC A08/MF A01	DE82019483	MN -95d	7:61693
T5	NTIS, PC A13/MF A01	DE82019338	MN -95d	7:61694
T6	NTIS, PC A13/MF A01	DE82019337	MN -95d	7:61695
DOE/DP/00789-				
T7	NTIS, PC A23/MF A01	DE82021981	MN -38	7:61874
DOE/DP/04515-				
2	NTIS, PC A09/MF A01	DE82021130	MN -11	7:62020
DOE/DP/40045-				
1	NTIS, PC A05/MF A01	DE82021926	MN -21	7:61885
DOE/DP/40141-				
1	NTIS, PC A02/MF A01	DE82019285	MN -21	7:61886
DOE/EIA-				
0239(81-82)	NTIS, PC A03/MF A01	DE82021217	STD -92	7:60884
0346	NTIS, PC A03/MF A01	DE82021872	MN -98E	7:61663
DOE/EML-				
406	NTIS, PC A03/MF A01	DE82021873	STD -11	7:60895
407	NTIS, PC A02/MF A01	DE82021874	STD -11	7:62009
DOE/EP-				
0046/ 2	NTIS, PC A02/MF A01	DE82021752	MN -92	7:60866
DOE/ER-				
0130	NTIS, PC A06/MF A01	DE82016020	STD -2	7:61239
0144	NTIS, PC A09/MF A01	DE82021016	STD -4	7:61825
DOE/ER/01797-				
99	NTIS, PC A03/MF A01	DE82021932	MN -4	7:61868
DOE/ER/02029-				
T3	NTIS, PC A03/MF A01	DE82017192	MN -25	7:61762

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DOE/ER/02528-T1	NTIS, PC A02/MF A01	DE82019422	MN -48	7:62110
DOE/ER/02528-T2	NTIS, PC A02/MF A01	DE82020383	MN -48	7:62111
DOE/ER/02534-8	NTIS, PC A04/MF A01	DE82021615	MN -66b	7:61193
DOE/ER/02968-143	NTIS, PC A03/MF A01	DE82021223	MN -4	7:61866
DOE/ER/03023-30	NTIS, PC A06/MF A01	DE82020749	MN -34D	7:62270
DOE/ER/03130-T8	NTIS MF A01	DE82019933	MN -28	7:62271
DOE/ER/03244-98	NTIS, PC A02/MF A01	DE82021914	MN -34D	7:62272
DOE/ER/03346-250	NTIS, PC A03/MF A01	DE82021939	MN -34C	7:62327
DOE/ER/03509-18	NTIS, PC A05/MF A01	DE82021935	MN -34D	7:62273
DOE/ER/03539-20	NTIS, PC A02/MF A01	DE82021049	MN -34D	7:62274
DOE/ER/04693-T3	NTIS, PC A02/MF A01	DE82019257	MN -34	7:61678
DOE/ER/05226-1	NTIS, PC A02/MF A01	DE82021942	MN -4	7:61850
DOE/ER/10364-33	NTIS, PC A03/MF A01	DE82021048	MN -34D	7:62305
DOE/ER/10366-4	NTIS, PC A02/MF A01	DE82021592	MN -61c	7:61862
DOE/ER/10554-21	NTIS, PC A08/MF A01	DE82020756	MN -4	7:61829
22	NTIS, PC A12/MF A01	DE82020759	MN -4	7:61856
27	NTIS, PC A04/MF A01	DE82020764	MN -4	7:61830
28	NTIS, PC A03/MF A01	DE82021581	MN -4	7:61831
DOE/ER/10566-T1	NTIS, PC A02/MF A01	DE82021627	MN -25	7:61763
DOE/ER/10612-8	NTIS, PC A09/MF A01	DE82020962	MN -4	7:61857
DOE/ER/10618-7	NTIS, PC A02/MF A01	DE82021831	MN -34A	7:62234
8	NTIS, PC A02/MF A01	DE82021632	MN -34A	7:62235
DOE/ER/10698-2	NTIS, PC A02/MF A01	DE82021940	MN -20	7:62469
DOE/ER/10767-1	NTIS, PC A02/MF A01	DE82019271	MN -20	7:62470
DOE/ER/40033-27	NTIS, PC A02/MF A01	DE82022009	MN -34C	7:62275
DOE/ER/53104-3	NTIS, PC A02/MF A01	DE82021052	MN -20f	7:62398
4	NTIS, PC A02/MF A01	DE82020896	MN -20g	7:62399
DOE/ER/53131-1	NTIS, PC A03/MF A01	DE82020971	MN -20a	7:62400
DOE/ET/08002-26	NTIS, PC A11/MF A01	DE82021944	STD -92a	7:60848
DOE/ET/10060-84-Vol.2	NTIS, PC A10/MF A01	DE82020063	STD -90d	7:60716
DOE/ET/10131-T7	NTIS, PC A18/MF A01	DE82016972	MN -90d	7:60717
DOE/ET/10137-T4	NTIS, PC A04/MF A01	DE82019929	STD -90d	7:60718
DOE/ET/10639-T1	NTIS, PC A06/MF A01	DE82011170	MN -90i	7:60719
DOE/ET/10666-T10	NTIS, PC A02/MF A01	DE82018080	MN -90c	7:60720
DOE/ET/11268-18	NTIS, PC A07/MF A01	DE82010509	STD -88	7:60804
DOE/ET/11338-1216	NTIS, PC A06/MF A01	DE82016392	STD -90c	7:60721
DOE/ET/12056-21	NTIS, PC A07/MF A01	DE82021605	STD -92a	7:60849
DOE/ET/12462-1	NTIS, PC A11/MF A01	DE82017787	STD -88	7:60805
DOE/ET/12512-2	NTIS, PC A07/MF A01	DE82016060	STD -90b	7:60824
DOE/ET/14259-T1	NTIS, PC A07/MF A01	DE82021180	STD -88	7:60806
DOE/ET/14880-01	NTIS, PC A05/MF A01	DE82019756	MN -90d	7:60722
02	NTIS, PC A03/MF A01	DE82019757	MN -90d	7:60723
03	NTIS, PC A04/MF A01	DE82019758	MN -90d	7:60724
04	NTIS, PC A11/MF A01	DE82019759	MN -90d	7:60725
05	NTIS, PC A04/MF A01	DE82019760	MN -90d	7:60726
06	NTIS, PC A04/MF A01	DE82019761	MN -90d	7:60727
07	NTIS, PC A05/MF A01	DE82019762	MN -90d	7:60728
08	NTIS, PC A12/MF A01	DE82019763	MN -90d	7:60729
09	NTIS, PC A03/MF A01	DE82019764	MN -90d	7:60730

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DOE/ET/15328-T1	NTIS, PC A02/MF A01	DE82008637	MN -25	7:61786
DOE/ET/15490-T14	NTIS, PC A02/MF A01	DE82019080	MN -90e	7:61240
DOE/ET/15614-T1	NTIS, PC A06/MF A01	DE81022414	STD -90g	7:61674
DOE/ET/20279-189	NTIS, PC A04/MF A01	DE82021123	STD -63	7:61062
191	NTIS, PC A04/MF A01	DE83000660	STD -63	7:61104
205	NTIS, PC A02/MF A01	DE82022237	STD -63	7:61105
210	NTIS, PC A06/MF A01	DE83000399	STD -63	7:61106
217	NTIS, PC A05/MF A01	DE82022236	STD -63	7:61107
DOE/ET/20415-4	NTIS, PC A03/MF A01	DE82021085	MN -63e	7:61063
DOE/ET/20434-1	NTIS, PC A07/MF A01	DE82021160	MN -63e	7:61103
DOE/ET/21002-17	NTIS, PC A02/MF A01	DE82021051	MN -64	7:61119
DOE/ET/25106-T1-Vol.3	NTIS, PC A15/MF A01	DE82019395	MN -96	7:61591
DOE/ET/26957-T1	NTIS, PC A03/MF A01	DE82020463	MN -94d	7:61863
DOE/ET/27026-T3	NTIS, PC A02/MF A01	DE82021809	MN -66c	7:61194
DOE/ET/27146-T12	NTIS, PC A03/MF A01	DE82021794	MN -66b	7:61196
DOE/ET/28341-T1	NTIS, PC A09/MF A01	DE82020596	MN -37	7:62190
DOE/ET/28368-T1	NTIS, PC A05/MF A01	DE82020245	MN -34B	7:62191
DOE/ET/28407-T2	NTIS, PC A08/MF A01	DE82020789	STD -66b	7:61165
DOE/ET/28424-6	NTIS, PC A07/MF A01	DE82019753	MN -66g	7:61199
DOE/ET/28425-T1	NTIS, PC A05/MF A01	DE82021365	MN -66b	7:61190
T2	NTIS, PC A07/MF A01	DE82021564	MN -66f	7:61191
DOE/ET/34022-5	NTIS (US Sales Only), MF A0104/MF A01	DE82021054	MN -78	7:61374
DOE/ET/34202-67	NTIS, PC A12/MF A01	DE82019887	MN -77	7:61331
DOE/ET/51013-46	NTIS, PC A04/MF A01	DE82015605	STD -20b	7:62471
57	NTIS, PC A03/MF A01	DE82022496	STD -20b	7:62472
DOE/ET/52023-27	NTIS, PC A03/MF A01	DE82021222	MN -25	7:61764
DOE/ET/52040-244	NTIS, PC A04/MF A01	DE82016818	MN -20	7:62401
245	NTIS, PC A03/MF A01	DE82016825	MN -20	7:62473
DOE/ET/53045-6	NTIS, PC A02/MF A01	DE82021221	MN -20g	7:62402
DOE/ET/53051-37	NTIS, PC A03/MF A01	DE82015672	STD -20g	7:62474
46	NTIS, PC A02/MF A01	DE82020990	STD -20f	7:62403
DOE/EV/01599-219-Pt.1	NTIS, PC A03/MF A01	DE82021861	MN -48	7:62030
219-Pt.4	NTIS, PC A06/MF A01	DE82021971	MN -48	7:62031
DOE/EV/01668-130	NTIS, PC A02/MF A01	DE82021528	MN -48	7:62160
DOE/EV/02502-20	NTIS, PC A03/MF A01	DE82022007	MN -48	7:62055
DOE/EV/03018-T5	NTIS, PC A10/MF A01	DE82019298	MN -4	7:61864
T6	NTIS, PC A08/MF A01	DE82020347	MN -4	7:61851
DOE/EV/03571-23	NTIS, PC A02/MF A01	DE82021228	MN -48	7:62115
DOE/EV/03972-T2	NTIS MF A01	DE82015013	MN -48	7:62161
DOE/EV/04268-9	NTIS, PC A04/MF A01	DE82021608	MN -48	7:62088
10	NTIS, PC A02/MF A01	DE82021580	MN -48	7:62089
DOE/EV/04331-08	NTIS, PC A04/MF A01	DE82021593	MN -11	7:62162
DOE/EV/04659-T1	NTIS, PC A02/MF A01	DE82021527	MN -48	7:62163
DOE/EV/10019-2-Vol.2-Pt.17	NTIS, PC A02/MF A01	DE82020579	STD -11	7:61987
DOE/EV/10117-T1-Vol.1	NTIS, PC A03/MF A01	DE82021526	MN -41	7:62164
T1-Vol.2	NTIS, PC A07/MF A01	DE82021584	MN -41	7:62165
DOE/EV/10259-T2	NTIS, PC A08/MF A01	DE82020942	MN -11	7:62032
DOE/EV/10298-3	NTIS, PC A16/MF A01	DE82020755	MN -91	7:60896
4	NTIS, PC A16/MF A01	DE82020762	MN -91	7:60906

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DOE/EV/10343-32	NTIS, PC A03/MF A01	DE82020926	MN -32	7:62090
DOE/EV/10363-3	NTIS, PC A02/MF A01	DE82021357	MN -4	7:61869
4	NTIS, PC A02/MF A01	DE82021355	MN -4	7:61870
DOE/EV/10687-2	NTIS, PC A02/MF A01	DE82021975	MN -11	7:62017
DOE/FE/15067-3	NTIS, PC A02/MF A01	DE82021188	MN -90c	7:61241
DOE/IA/10150-T1	NTIS, PC A14/MF A01	DE82014492	MN -98F	7:61642
DOE/ID/01745-T1	NTIS, PC A02/MF A01	DE82021559	MN -90g	7:61675
DOE/ID/12033-T1	NTIS MF A01	DE82021740	MN -66a	7:61166
DOE/ID/12101-5	NTIS, PC A10/MF A01	DE82021076	MN -66	7:61159
DOE/ID/12348-T1	NTIS, PC A02/MF A01	DE82020738	MN -70	7:60978
DOE/JPL-1012-74	NTIS, PC A03/MF A01	DE83000452	STD -63b	7:61064
1012-75	NTIS, PC A04/MF A01	DE83000453	STD -63b	7:61065
1012-77	NTIS, PC A03/MF A01	DE83000159	STD -63b	7:61066
1012-78	NTIS, PC A03/MF A01	DE83000455	STD -63b	7:61067
DOE/LC/10036-T11	NTIS, PC A07/MF A01	DE82018560	STD -91	7:60885
DOE/MC/10190-T1	NTIS, PC A03/MF A01	DE82015864	MN -90	7:60731
DOE/MC/14380-1210-Vol.1	NTIS, PC A09/MF A01	DE82015612	STD -90c	7:60732
DOE/MC/14400-06	NTIS, PC A04/MF A01	DE82016246	MN -90c	7:60733
DOE/MC/16477-T4	NTIS, PC A02/MF A01	DE82015776	MN -90c	7:60734
DOE/METC-82-47	NTIS, PC A25/MF A01	DE82018281	STD -90c	7:60774
DOE/NASA-0277-1	NTIS, PC A07/MF A01	DE82021964	STD -90d	7:60746
DOE/NASA/0161-10	NTIS, PC A17/MF A01	DE82019982	STD -93	7:61679
DOE/NASA/10350-34	NTIS, PC A02/MF A01	DE82020329	STD -90d	7:60833
DOE/NBM-1043-Vol.1	NTIS, PC A10/MF A01	DE82021294	STD -64	7:61120
2020543	NTIS, PC A02/MF A01	DE82020543	MN -11	7:61015
2020919	NTIS, PC A02/MF A01	DE82020919	MN -41	7:61988
2021060	NTIS, PC A14/MF A01	DE82021060	MN -51	7:60914
2021316	NTIS, PC A03/MF A01	DE82021316	STD -64	7:61121
2021741	NTIS, PC A09/MF A01	DE82021741	MN -70	7:60979
3000003	NTIS, PC A06/MF A01	DE83000003	STD -64	7:61122
DOE/NE-0030/ 5-82	NTIS, PC A03/MF A01	DE82021148	STD -2	7:61363
DOE/NV/10250-3	NTIS, PC A03/MF A01	DE82021996	MN -70	7:60980
DOE/NV/10253-1	NTIS, PC A08/MF A01	DE82021354	MN -70	7:60981
DOE/NWTS-33-3	NTIS, PC A03/MF A01	DE82021021	STD -70	7:60982
DOE/PC/30018-3	NTIS, PC A06/MF A01	DE82021594	STD -90d	7:60747
DOE/PC/30214-T4	NTIS, PC A02/MF A01	DE82020247	MN -90e	7:61904
DOE/PC/30235-T2	NTIS, PC A04/MF A01	DE82018227	STD -90b	7:60825
DOE/PC/30246-1237	NTIS, PC A10/MF A01	DE82020723	STD -90i	7:60793
DOE/PC/30305-T5	NTIS, PC A04/MF A01	DE82019770	STD -90e	7:60834
DOE/PC/40782-T2	NTIS, PC A02/MF A01	DE82019079	MN -90d	7:60748
DOE/PC/40789-T1	NTIS, PC A02/MF A01	DE82015159	MN -90i	7:60768
DOE/PETC/TR-82/ 15	NTIS, PC A15/MF A01	DE82022070	STD -90b	7:60749
DOE/R5/10242-T1	NTIS, PC A03/MF A01	DE82021596	MN -60	7:61215
DOE/R5/10251-T1	NTIS MF A01	DE82016652	MN -95e	7:61724
DOE/RA-23211	NTIS, PC A06/MF A01	DE82021530	STD -97e	7:61044
DOE/RA/02625-T1	NTIS, PC A03/MF A01	DE82007994	MN -90c	7:60841
DOE/RA/03395-T1-Vol.1	NTIS, PC A09/MF A01	DE82021168	MN -97c	7:61260
T1-Vol.2	NTIS, PC A06/MF A01	DE82021167	MN -97c	7:61261

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DOE/RA/50297-T1	NTIS, PC A13/MF A01	DE82020534	MN -61a	7:61725
DOE/RA/50387-T1	NTIS, PC A08/MF A01	DE82021930	MN -61a	7:61068
DOE/RA/50393-1241	NTIS, PC A02/MF A01	DE82022000	STD -90c	7:60750
DOE/RG/06299-T1	NTIS, PC A03/MF A01	DE82021820	MN -92	7:60856
DOE/RG/06435-T1	NTIS, PC A07/MF A01	DE82021790	MN -92	7:60852
T2	NTIS, PC A04/MF A01	DE82021609	MN -92	7:60853
DOE/RG/06623-T1	NTIS, PC A04/MF A01	DE82021284	MN -98B	7:60857
DOE/RL/10120-1	NTIS, PC A03/MF A01	DE82020316	MN -94e	7:61588
DOE/SF/10542-T1	NTIS, PC A05/MF A01	DE82014662	STD -59c	7:61129
DOE/SF/10855-82-4	NTIS, PC A12/MF A01	DE82022220	MN -66a	7:61160
T1	NTIS, PC A17/MF A01	DE82020721	MN -66a	7:61167
DOE/TIC-4045-S2	NTIS, PC A99/MF A01	DE82014296	STD -2	7:62564
DOE/TIC/EGC-82/ 2	NTIS, PC A05/MF A01	DE82003279	MN -13	7:61672
DOE/UMT-0211	NTIS, PC A03/MF A01	DE82022037	MN -70A	7:60983
DOL/CLDS/PP-3	*See* DOE/ER-0130	DE82016020	STD -2	7:61239
DP-82-157-1	NTIS, PC A04/MF A01	DE83000531	STD -70	7:60984
DPSPU-77-11-24	NTIS, PC A02/MF A01	DE82015844	MN -70	7:60985
82-30-4	NTIS, PC A02/MF A01	DE82016268	MN -46	7:60953
DPST-81-141-11	*See* GJBX-204-82	DE82021064	MN -51	7:60934
81-141-14	*See* GJBX-205-82	DE82021071	MN -51	7:60935
81-141-20	*See* GJBX-206-82	DE82021070	MN -51	7:60936
81-141-23	*See* GJBX-207-82	DE82021069	MN -51	7:60937
81-141-26	*See* GJBX-208-82	DE82021068	MN -51	7:60938
81-141-29	*See* GJBX-209-82	DE82021067	MN -51	7:60939
E-82-10028	NTIS, PC A12/MF A01			7:60915
ECN-112	NTIS (US Sales Only), MF A0103/MF A01	DE82702696	MN -20	7:62475
EFI-468(10) -81	NTIS (US Sales Only), MF A0102/MF A01	DE82702692	MN -34A	7:62236
EGG-1183-1841	NTIS, PC A02/MF A01	DE82021366	MN -32	7:62546
2123	*See* NUREG/CR-2757		MN -78	7:61309
2193	NTIS, PC A04/MF A01	DE83000263	MN -61a	7:61735
2202	*See* NUREG/CR-2776		MN -41	7:61543
EIR-407	NTIS (US Sales Only), MF A0107/MF A01	DE82902938	MN -59c	7:61146
434	NTIS (US Sales Only), MF A0103/MF A01	DE82906235	MN -48	7:62116
435	NTIS (US Sales Only), MF A0102/MF A01	DE82906204	MN -41	7:62117
437	NTIS (US Sales Only), MF A0107/MF A01	DE82906225	MN -77	7:61343
439	NTIS (US Sales Only), MF A0107/MF A01	DE82906236	MN -77	7:61344
ENDF-323	*See* ORNL/TM-8185	DE82021092	MN -79d	7:61426
325	*See* ORNL/TM-8283	DE82021115	STD -79d	7:61349
ENEA-RT-EC-82-1	NTIS (US Sales Only), MF A0107/MF A01	DE82906297	MN -98	7:61726
ENICO-1111	*See* NUREG/CR-2438		MN -11	7:62012
1116-Suppl.1	NTIS, PC A03/MF A01	DE82021597	MN -11	7:61989
1118	NTIS, PC A03/MF A01	DE82022041	STD -70	7:61016
EPA-600/ 9-79-006	*See* PB-82-189556			7:61994
EPRI-AP-2221	NTIS, PC A08/MF A01	DE82904631	MN -90	7:60751
2435-SY	NTIS, PC A04/MF A01	DE82906454	MN -62d	7:61116
2517	NTIS, PC A08/MF A01	DE82905496	MN -90f	7:60835
2518	NTIS, PC A09/MF A01	DE82906452	MN -90f	7:61242
2521	NTIS, PC A09/MF A01	DE82906453	MN -21	7:62476
2535	NTIS, PC A07/MF A01	DE82906456	MN -90a	7:60752
2536	NTIS, PC A06/MF A01	DE82905494	MN -90f	7:61243
2544	NTIS, PC A05/MF A01	DE82906455	MN -63	7:61108
2554	NTIS, PC A10/MF A01	DE82905495	MN -90f	7:61244
EPRI-CS-2359	NTIS MF A01	DE82904643	MN -90d	7:60794
2498	NTIS, PC A06/MF A01	DE82905827	MN -90i	7:62035
2513	NTIS, PC A04/MF A01	DE82021378	MN -90i	7:62018
2558	NTIS, PC A06/MF A01	DE82021340	MN -90i	7:62036
EPRI-EA-1904	NTIS, PC A06/MF A01	DE82906472	MN -11	7:61990

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1907	NTIS, PC A09/MF A01	DE82906473	MN -11	7:61991
2447-SY	NTIS, PC A07/MF A01	DE82906440	MN -92	7:60858
2538-SR	NTIS, PC A03/MF A01	DE82906490	MN -11	7:62044
2540-Vol.1	NTIS, PC A06/MF A01	DE82906492	MN -11	7:61620
2552	NTIS, PC A06/MF A01	DE82906491	MN -98E	7:61664
2566-SR	NTIS, PC A16/MF A01	DE82906493	MN -97d	7:61665
EPRI-EL-				
2532	NTIS, PC A11/MF A01	DE82906481	MN -97c	7:61262
2549	NTIS, PC A05/MF A01	DE82906478	MN -97c	7:61263
2561-Vol.1	NTIS, PC A14/MF A01	DE82906479	MN -97c	7:61666
2561-Vol.2	NTIS, PC A09/MF A01	DE82906477	MN -97c	7:61667
2563	NTIS, PC A04/MF A01	DE82906476	MN -97a	7:61264
EPRI-EM-				
2485	NTIS, PC A15/MF A01	DE82905803	MN -94a	7:61245
2573-Vol.1-Exec.Summ.	NTIS, PC A04/MF A01	DE82906475	MN -12	7:61727
2579	NTIS, PC A11/MF A01	DE82906459	MN -94cb	7:61592
EPRI-NP-				
1881	NTIS, PC A07/MF A01	DE82906469	MN -80	7:61295
2099-Vols.1-3	NTIS MF A01	DE82904049	MN -80	7:61444
2503	NTIS, PC A04/MF A01	DE82906447	MN -78	7:61500
2505	NTIS, PC A04/MF A01	DE82906470	MN -80	7:61316
2541	NTIS, PC A14/MF A01	DE82906483	MN -78	7:61317
2543	NTIS, PC A05/MF A01	DE82906461	MN -80	7:61318
2547	NTIS, PC A13/MF A01	DE82906460	MN -78	7:61501
2560	NTIS, PC A07/MF A01	DE82906464	MN -78	7:61296
ESG-DOE-				
13377	*See* DOE/PC/30018-3	DE82021594	STD -90d	7:60747
EUR-				
6756-FR	European Community Information Service, 2100 M Street NW, Washington, DC 20037		ND -98	7:61604
6762-FR-Vol.4	European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037		ND -13	7:61605
6762-FR-Vol.5	European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037		ND -13	7:61606
7006-DE	Commission of the European Communities, Luxembourg			7:61728
7015-FR	European Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037		ND -63	7:61069
7038-DE	Commission of the European Communities, Luxembourg			7:61037
7061-DE	Commission of the European Communities, Directorate-General for Information Market and Innovation, Jean Monnet Building, Luxembourg		ND -95e	7:61729
7086-EN	NTIS, PC A02/MF A01			7:62346
7113-IT	European Community Information Service, 2100 M St., N.W., Washington, DC 20037		ND -66	7:61168
7133-DE	Commission of the European Communities, Luxembourg			7:61696
7312-FR	European Community Information Service, 2100 M Street, N.W., Suite 707, Washington, DC 20037		ND -59c	7:61046
7386-IT	European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037		ND -94	7:61038
7387-DE	Euorpean Community Information Service, 2100 M Street, NW, Suite 707, Washington, DC 20037		ND -25	7:61730
7555-FR	Commission of the European Communities, Directorate-General for Information Market and Innovation, Jean Monnet Building, Luxembourg		ND -61a	7:61070
7557-FR	CEC, Information Market and Innovation, Luxembourg		ND -61a	7:61071
7559-FR	European Community Information Service, 2100 M Street NW, Suite 707, Washington, DC 20037		ND -90c	7:61072
7578-DE	Commission of the European Communities, Luxembourg			7:61169
7688-EN	European Community Information Service, 2100 M Street, N.W., Suite 707, Washington, DC 20037		ND -59	7:61073
7698-DE	European Community Information Service, 2100 M Street, N.W., Suite 707, Washington, DC 20037		ND -59c	7:61155
7779-EN	European Community Information Service, 2100 M Street NW, Washington, DC 20037		ND -98	7:61607
FE-				
2247-30	*See* DOE/ET/10137-T4	DE82019929	STD -90d	7:60718
2291-80A1	*See* CW-WR-76-020.80A	DE81028443	STD -90e	7:61238
2356-154	*See* DOE/ET/10666-T10	DE82018080	MN -90c	7:60720
2566-50	*See* DOE/ET/10131-T7	DE82016972	MN -90d	7:60717
5490-35	*See* DOE/ET/15490-T14	DE82019080	MN -90e	7:61240
FEI-				
1161	NTIS (US Sales Only), MF A0102/MF A01	DE82702661	MN -80	7:61338
1192	NTIS (US Sales Only), MF A0102/MF A01	DE82702674	MN -79	7:61383
1198	NTIS (US Sales Only), MF A0102/MF A01	DE82702526	MN -46	7:62347
1200	NTIS (US Sales Only), MF A0102/MF A01	DE82702648	MN -38	7:61445
1201	NTIS (US Sales Only), MF A0102/MF A01	DE82702649	MN -38	7:61446
1203	NTIS (US Sales Only), MF A0102/MF A01	DE82702650	MN -38	7:61464
1204	NTIS (US Sales Only), MF A0102/MF A01	DE82702651	MN -38	7:61447
1210	NTIS (US Sales Only), MF A0102/MF A01	DE82702652	MN -38	7:61448
1214	NTIS (US Sales Only), MF A0102/MF A01	DE82702527	MN -46	7:62348
1218	NTIS (US Sales Only), MF A0102/MF A01	DE82702653	MN -38	7:61449
1219	NTIS (US Sales Only), MF A0102/MF A01	DE82702662	MN -80	7:61384
1221	NTIS (US Sales Only), MF A0102/MF A01	DE82702654	MN -38	7:61465
1222	NTIS (US Sales Only), MF A0102/MF A01	DE82702655	MN -38	7:61466

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1223	NTIS (US Sales Only), MF A0102/MF A01	DE82702663	MN -80	7:61385
1227	NTIS (US Sales Only), MF A0102/MF A01	DE82702664	MN -80	7:61386
1236	NTIS (US Sales Only), MF A0102/MF A01	DE82702656	MN -38	7:61450
FERMILAB/TM-				
1126	NTIS MF A01	DE82021919	MN -28	7:61922
FHWA/TX-				
82/ 24-225-24	NTIS, PC A05/MF A01	DE82906165	MN -96	7:61715
FOA-C-				
20427-T1	NTIS, PC A04/MF A01			7:62192
GA-A-				
15603	NTIS, PC A06/MF A01	DE82021663	STD -77	7:61345
16426	NTIS, PC A06/MF A01	DE83000404	STD -20c	7:62477
GAO/CED-				
81-145	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -88	7:61656
82-28	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -13	7:62540
GAO/EMD-				
81-119	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -88	7:61657
81-128	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -13	7:61658
82-23	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -13	7:61659
82-78	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -95	7:61697
GAO/GGD-				
82-48	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -92	7:61660
GAO/PLRD-				
81-49	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -90d	7:60845
82-64	General Accounting Office, PO Box 6015, Gaithersburg, MD 20760		MN -95	7:61716
GEFR-				
00595	NTIS, PC A10/MF A01	DE82021226	MN -77	7:61332
GEND-				
015	NTIS, PC A02/MF A01	DE82022228	STD -78	7:61502
024	NTIS, PC A03/MF A01	DE82021310	STD -78	7:61319
025	NTIS, PC A03/MF A01	DE82022513	STD -78	7:61320
GJBX-				
15-82	NTIS MF A01	DE82020452	MN -51	7:60916
68-82	NTIS MF A01	DE82021682	MN -51	7:60917
71-82	NTIS MF A01	DE82020434	MN -51	7:60918
72-82	NTIS MF A01	DE82020433	MN -51	7:60919
73-82	NTIS MF A01	DE82021681	MN -51	7:60920
74-82	NTIS MF A01	DE82021680	MN -51	7:60921
75-82	NTIS MF A01	DE82020432	MN -51	7:60922
76-82	NTIS MF A01	DE82021679	MN -51	7:60923
77-82	NTIS MF A01	DE82021678	MN -51	7:60924
79-82	NTIS MF A01	DE82021676	MN -51	7:60925
81-82	NTIS MF A01	DE82021675	MN -51	7:60926
82-82	NTIS MF A01	DE82021674	MN -51	7:60927
83-82	NTIS MF A01	DE82021673	MN -51	7:60928
84-82	NTIS MF A01	DE82021672	MN -51	7:60929
86-82	NTIS MF A01	DE82020428	MN -51	7:60930
108-82	NTIS MF A01	DE82021671	MN -51	7:60931
122-82	NTIS MF A01	DE82021669	MN -51	7:60932
178-82	NTIS MF A01	DE82021668	MN -51	7:60933
204-82	NTIS PCE11/MF A01	DE82021064	MN -51	7:60934
205-82	NTIS PCE01/MF A01	DE82021071	MN -51	7:60935
206-82	NTIS, PC A03/MF A01	DE82021070	MN -51	7:60936
207-82	NTIS PCE06/MF A01	DE82021069	MN -51	7:60937
208-82	NTIS, PC A03/MF A01	DE82021068	MN -51	7:60938
209-82	NTIS, PC A03/MF A01	DE82021067	MN -51	7:60939
GJO-				
100-82	NTIS, PC A05/MF A01	DE82021651	MN -51	7:60913
HE-				
80-053-795	*See* PB-82-189770			7:62185
HEDL-SA-				
2595	NTIS, PC A02/MF A01	DE82016263	MN -79k	7:61346
2674-FP	NTIS MF A01	DE82016157	MN -20d	7:62478
HEDL-TC-				
1502-Rev.1	NTIS, PC A03/MF A01	DE82021028	MN -85	7:60986
1729	NTIS, PC A03/MF A01	DE83000269	MN -70	7:60987
1787	NTIS, PC A02/MF A01	DE82021027	MN -85	7:61297
HEDL-TME-				
81-46	NTIS, PC A04/MF A01	DE82021532	STD -20	7:62479
HEHF-				
22	NTIS, PC A02/MF A01	DE82015461	MN -41	7:62118
24	NTIS, PC A02/MF A01	DE82015464	MN -41	7:62119
28	NTIS, PC A03/MF A01	DE82015467	MN -41	7:62120
30	NTIS, PC A04/MF A01	DE82015468	MN -41	7:62121
30-App.4	NTIS, PC A10/MF A01	DE82015469	MN -41	7:62122
32	NTIS, PC A03/MF A01	DE82015470	MN -41	7:62123

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34	NTIS, PC A03/MF A01	DE82015471	MN -41	7:62124
HHE-				
80-033-815	*See* PB-82-190067			7:61996
80-104-101	*See* PB-82-189705			7:60842
HRP-				
0904095/ 7	NTIS, PC A03/MF A01			7:62091
0904134/ 4	NTIS, PC A06/MF A01			7:61736
HU-TFT-				
81-28	NTIS (US Sales Only), MF A0104/MF A01	DE82702685	MN -34D	7:62294
81-30	NTIS (US Sales Only), MF A0103/MF A01	DE82702686	MN -34D	7:62295
81-38	NTIS (US Sales Only), MF A0102/MF A01	DE82702687	MN -34D	7:62377
HW-				
73457	NTIS MF A01	DE82021370	MN -80	7:61482
IAE-				
3389/ 6	NTIS (US Sales Only), MF A0103/MF A01	DE82702611	MN -20	7:62404
3396/ 1	NTIS (US Sales Only), MF A0103/MF A01	DE82702600	MN -34D	7:62386
IAEA-TECDOC-				
248	NTIS (US Sales Only), MF A0105/MF A01	DE82702469	MN -41	7:61503
ICTIS-BIB-				
2	IEA Coal Research, 14-15 Lower Grosvenor Place, London, England SW1W 0EX			7:60801
IDO-				
1735-1	NTIS, PC A10/MF A01	DE82021807	STD -97e	7:61045
10104	NTIS, PC A06/MF A01	DE82015410	MN -61a	7:61074
IFVE-OEF-				
81-93	NTIS (US Sales Only), MF A0102/MF A01	DE82702617	MN -34D	7:62282
IFVE-ONF/FTO/PK-				
80-145	NTIS (US Sales Only), MF A0103/MF A01	DE82701638	MN -34D	7:62292
IFVE-OTF-				
81-155	NTIS (US Sales Only), MF A0102/MF A01	DE82702612	MN -34D	7:62276
IIASA-RR-				
82-13	Laxenburg, Austria; International Institute for Applied Systems Analysis (1982).			7:61609
INFN/FM-				
80/ 1	NTIS (US Sales Only), MF A0102/MF A01	DE82903240	MN -22	7:62307
INFN/TC-				
81/ 9	NTIS (US Sales Only), MF A01	DE82903259	MN -38	7:61936
INIS-mf-				
6822	NTIS (US Sales Only), MF A0103/MF A01	DE82780740	MN -80	7:61516
6844	NTIS (US Sales Only), MF A0103/MF A01	DE82780741	MN -2	7:61626
7048	NTIS (US Sales Only), MF A0112/MF A01	DE82780692	MN -2	7:61887
7145	NTIS (US Sales Only), MF A01XX/MF A01	DE82780735	MN -34C	7:62333
7147	NTIS (US Sales Only), MF A01XX/MF A01	DE82780736	MN -34C	7:62320
7149	NTIS (US Sales Only), MF A01XX/MF A01	DE82780737	MN -34C	7:62334
7195	NTIS (US Sales Only), MF A0106/MF A01	DE82780738	MN -34C	7:62309
INP-				
1069/ PL	NTIS (US Sales Only), MF A0123/MF A01	DE82780744	MN -48	7:62125
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2119-RPE/ 343	NTIS, PC A02/MF A01			7:62222
2172-RPE/ 388	NTIS, PC A03/MF A01			7:62223
2202-PRE/ 011	NTIS, PC A02/MF A01			7:62224
2214-PRE/ 014	NTIS, PC A02/MF A01			7:60877
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IPF-				
80-8	NTIS, PC A06/MF A01			7:62480
80-10	NTIS, PC A03/MF A01			7:62405
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81-1	NTIS, PC A05/MF A01			7:62481
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269	NTIS, PC A04/MF A01			7:61216
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271	NTIS, PC A06/MF A01			7:61218
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273	NTIS, PC A03/MF A01			7:61220
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275	NTIS, PC A04/MF A01			7:61222
ISH-				
7	NTIS (US Sales Only), MF A0102/MF A01	DE82906234	MN -41	7:62021
ITA-				
82-06-504	NTIS PC$15.00/MF A01			7:61246
ITEP-				
134(1981)	NTIS (US Sales Only), MF A0103/MF A01	DE82702613	MN -34D	7:62202
ITF-				
82-54E	Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR		ND -34C	7:62310
82-74P	Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR		ND -34D	7:62367
82-75P	Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR		ND -34	7:62263
82-79P	Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR		ND -34A	7:62368
82-84P	Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR		ND -34D	7:62369
82-96P	Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR		ND -34C	7:62335

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82-99E	Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR		ND -34	7:62370
82-IIIP	Information Dept., Institute for Theoretical Physics 252130, Kiev-130, USSR		ND -34A	7:62371
JACKFAU-				
81-252-2	NTIS, PC A05/MF A01	DE82021283	MN -98	7:61608
JAERI-M-				
9653	NTIS (US Sales Only), MF A0102/MF A01	DE82702697	MN -20	7:62406
JINR-				
6-81-388	NTIS (US Sales Only), MF A0102/MF A01	DE82702533	MN -34C	7:62321
E-1-81-576	NTIS (US Sales Only), MF A0102/MF A01	DE82702534	MN -34C	7:62277
E-2-81-608	NTIS (US Sales Only), MF A0102/MF A01	DE82702688	MN -34D	7:62378
E-2-81-631	NTIS (US Sales Only), MF A0102/MF A01	DE82702614	MN -34D	7:62283
E-2-81-666	NTIS (US Sales Only), MF A0102/MF A01	DE82702601	MN -34D	7:62387
E-4-81-637	NTIS (US Sales Only), MF A0102/MF A01	DE82702529	MN -34C	7:62314
R-1-81-599	NTIS (US Sales Only), MF A0102/MF A01	DE82702528	MN -34C	7:62349
R-1-81-678	NTIS (US Sales Only), MF A0102/MF A01	DE82702618	MN -34D	7:62284
R-2-81-197	NTIS (US Sales Only), MF A0102/MF A01	DE82702615	MN -34D	7:62285
R-2-81-655	NTIS (US Sales Only), MF A0102/MF A01	DE82702602	MN -34D	7:62296
R-2-81-701	NTIS (US Sales Only), MF A0102/MF A01	DE82702603	MN -34D	7:62297
R-4-81-238	NTIS (US Sales Only), MF A0102/MF A01	DE82702530	MN -34C	7:62322
R-5-81-188	NTIS (US Sales Only), MF A0102/MF A01	DE82702689	MN -34D	7:62379
R-6-81-454	NTIS (US Sales Only), MF A0102/MF A01	DE82702535	MN -34C	7:62323
R-14-81-564	NTIS (US Sales Only), MF A0102/MF A01	DE82702694	MN -34A	7:61765
R-14-81-629	NTIS (US Sales Only), MF A0102/MF A01	DE82702695	MN -34A	7:62350
JINR-D-				
1-81-592	NTIS (US Sales Only), MF A0102/MF A01	DE82702693	MN -34A	7:62351
JINR-R-				
9-81-711	NTIS (US Sales Only), MF A0102/MF A01	DE82702660	MN -28	7:61918
JPL-PUBL-				
82-65	*See* DOE/JPL-1012-74	DE83000452	STD -63b	7:61064
82-73	*See* DOE/JPL-1012-75	DE83000453	STD -63b	7:61065
82-81	*See* DOE/JPL-1012-77	DE83000159	STD -63b	7:61066
82-82	*See* DOE/JPL-1012-78	DE83000455	STD -63b	7:61067
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79780	*See* N-82-17844			7:62179
79780	*See* N-82-17844			7:62180
79780	*See* N-82-17844			7:62181
79780	*See* N-82-17844			7:62182
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JSR-				
81-26	NTIS, PC A04/MF A01	DE82018220	MN -58b	7:61147
JUEL-				
1666	NTIS, PC A02/MF A01			7:62482
1750	*See* GEFR-00595	DE82021226	MN -77	7:61332
Juel-Spez-				
108	NTIS (US Sales Only), MF A0106/MF A01	DE82902575	MN -60	7:61223
JYFL-RR-				
18/ 81	NTIS (US Sales Only), MF A0105/MF A01		MN -34C	7:62315
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2031	NTIS, PC A02/MF A01	DE82021533	STD -11	7:62037
K/UR-				
423	*See* GJBX-68-82	DE82021682	MN -51	7:60917
426	*See* GJBX-71-82	DE82020434	MN -51	7:60918
427	*See* GJBX-72-82	DE82020433	MN -51	7:60919
428	*See* GJBX-73-82	DE82021681	MN -51	7:60920
429	*See* GJBX-74-82	DE82021680	MN -51	7:60921
430	*See* GJBX-75-82	DE82020432	MN -51	7:60922
431	*See* GJBX-76-82	DE82021679	MN -51	7:60923
432	*See* GJBX-77-82	DE82021678	MN -51	7:60924
434	*See* GJBX-79-82	DE82021676	MN -51	7:60925
436	*See* GJBX-81-82	DE82021675	MN -51	7:60926
437	*See* GJBX-82-82	DE82021674	MN -51	7:60927
438	*See* GJBX-83-82	DE82021673	MN -51	7:60928
439	*See* GJBX-84-82	DE82021672	MN -51	7:60929
441	*See* GJBX-86-82	DE82020428	MN -51	7:60930
KFK-				
3228	NTIS (US Sales Only), MF A0112/MF A01	DE82780742	MN -28	7:61911
KFTI-				
81-34	NTIS (US Sales Only), MF A0102/MF A01	DE82702698	MN -20	7:62407
KMSF-U-				
1200	NTIS, PC A02/MF A01	DE82020737	MN -21	7:61024
LA-				
9111-M-Rev.	NTIS, PC A03/MF A01	DE82021259	STD -32	7:62547
9265	NTIS, PC A09/MF A01	DE82021845	STD -15	7:61020
9271-MS	NTIS, PC A02/MF A01	DE82021219	STD -38	7:61958
9282-MS	NTIS, PC A02/MF A01	DE82016374	STD -15	7:61021
9382-MS	NTIS, PC A02/MF A01	DE82021263	STD -20c	7:62483
9417-MS	NTIS, PC A04/MF A01	DE82021174	STD -25	7:61362
9425-MS	NTIS, PC A03/MF A01	DE82021257	STD -59c	7:61130
9442-PR-Vol.1	*See* NUREG/CR-2814-Vol.1		MN -80	7:61545
9453-MS	NTIS, PC A02/MF A01	DE82021264	STD -20g	7:62484

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9458-T	NTIS, PC A12/MF A01	DE82021149	MN -11	7:61621
9485-MS	NTIS, PC A04/MF A01	DE82021140	STD -98F	7:61641
9489-MS	NTIS, PC A02/MF A01	DE82021253	STD -45	7:61959
9495-MS	NTIS, PC A02/MF A01	DE82021218	STD -32	7:62388
9501-MS	NTIS, PC A02/MF A01	DE82021271	STD -32	7:62548
9503-MS	NTIS, PC A02/MF A01	DE82021260	STD -32	7:62549
LA-tr-				
82-27	NTIS, PC A02/MF A01	DE82021913	MN -45	7:61842
LA-UR-				
82-1026	NTIS, PC A03/MF A01	DE82014082	MN -78	7:61520
82-2302	NTIS, PC A02/MF A01	DE82021924	MN -34B	7:62203
82-2304	NTIS, PC A02/MF A01	DE82021925	MN -34B	7:62204
82-2340	NTIS, PC A02/MF A01	DE82021771	MN -20g	7:62408
82-2341	NTIS, PC A03/MF A01	DE82021772	MN -34C	7:61302
82-2347	NTIS, PC A02/MF A01	DE82021775	MN -34B	7:62205
82-2372	NTIS, PC A02/MF A01	DE82021879	MN -70	7:60989
82-2391	NTIS, PC A02/MF A01	DE82021882	MN -21	7:62485
82-2400	NTIS, PC A02/MF A01	DE82021883	MN -28	7:61901
82-2429	NTIS, PC A02/MF A01	DE82021891	MN -78	7:61521
82-2456	NTIS, PC A02/MF A01	DE82021894	MN -34C	7:62324
82-2460	NTIS, PC A02/MF A01	DE82021895	MN -48	7:62126
82-2461	NTIS, PC A02/MF A01	DE82021896	MN -34B	7:62206
82-2466	NTIS, PC A04/MF A01	DE82021897	MN -20f	7:62409
82-2476	NTIS, PC A02/MF A01	DE82021898	MN -37	7:61952
82-2497	NTIS, PC A02/MF A01	DE82021761	MN -59a	7:61131
82-2498	NTIS, PC A02/MF A01	DE82021762	MN -78	7:61522
82-2529	NTIS, PC A02/MF A01	DE82022021	MN -34C	7:62410
82-2531	NTIS, PC A02/MF A01	DE82022020	MN -20f	7:62486
82-2532	NTIS, PC A02/MF A01	DE82022019	MN -70	7:60990
82-2533	NTIS, PC A02/MF A01	DE82022018	MN -70	7:60991
82-2534	NTIS, PC A02/MF A01	DE82022017	MN -70A	7:60992
82-2535	NTIS, PC A03/MF A01	DE82021802	MN -70	7:60993
82-2543	NTIS, PC A02/MF A01	DE82022014	MN -20f	7:62411
82-2558	NTIS, PC A02/MF A01	DE82022013	MN -34B	7:62207
LAFI-				
028	NTIS (US Sales Only), MF A0102/MF A01	DE82702604	MN -34A	7:61787
030	NTIS (US Sales Only), MF A0102/MF A01	DE82702605	MN -34A	7:61788
035	NTIS (US Sales Only), MF A0102/MF A01	DE82702606	MN -34A	7:61789
036	NTIS (US Sales Only), MF A0102/MF A01	DE82702607	MN -34A	7:61790
038	NTIS (US Sales Only), MF A0102/MF A01	DE82702608	MN -34A	7:61791
041	NTIS (US Sales Only), MF A0102/MF A01	DE82702609	MN -34A	7:61792
042	NTIS (US Sales Only), MF A0102/MF A01	DE82702610	MN -34A	7:61793
LALP-				
82-18	NTIS, PC A05/MF A01	DE82021166	MN -38	7:61875
LBL-				
10627	NTIS, PC A03/MF A01	DE82021963	STD -48	7:62056
13150	NTIS, PC A03/MF A01	DE82020574	STD -41	7:61917
13416-Rev.	NTIS, PC A03/MF A01	DE82022058	MN -48	7:62127
14235	NTIS, PC A02/MF A01	DE82021684	STD -11	7:61992
14284	NTIS, PC A03/MF A01	DE82022054	MN -25	7:61794
14304	NTIS, PC A08/MF A01	DE82020600	STD -94c	7:61593
14305	NTIS, PC A05/MF A01	DE82020599	STD -94c	7:61594
14489	NTIS, PC A06/MF A01	DE82020542	MN -34D	7:62352
14491	NTIS, PC A05/MF A01	DE82020980	MN -90d	7:60753
14598	NTIS, PC A02/MF A01	DE82020518	MN -4	7:61852
14612	NTIS, PC A09/MF A01	DE82020975	MN -25	7:61766
14621	NTIS, PC A03/MF A01	DE82020293	MN -25	7:61795
14647	NTIS, PC A02/MF A01	DE82020100	MN -34D	7:62298
14674	NTIS, PC A03/MF A01	DE82020608	STD -94cb	7:61595
14705	NTIS, PC A03/MF A01	DE82020541	MN -4	7:61853
14733	NTIS, PC A03/MF A01	DE82020978	MN -95d	7:61698
14735	NTIS, PC A02/MF A01	DE82022055	MN -95d	7:61699
14749	NTIS, PC A06/MF A01	DE82022057	MN -25	7:61878
14755	NTIS, PC A02/MF A01	DE82019739	MN -25	7:61807
14772	NTIS, PC A03/MF A01	DE82022068	MN -48	7:62128
14779	NTIS, PC A02/MF A01	DE82020315	MN -48	7:62361
14794	NTIS, PC A04/MF A01	DE83000543	STD -94cb	7:61075
14799	NTIS, PC A02/MF A01	DE82020979	MN -64	7:61123
14815	NTIS, PC A06/MF A01	DE82021788	MN -94c	7:61596
LCC-				
013/ 80	NTIS (US Sales Only), MF A0102/MF A01	DE82702665	MN -80	7:61455
014/ 80	NTIS (US Sales Only), MF A0103/MF A01	DE82702666	MN -80	7:61456
015/ 80	NTIS (US Sales Only), MF A0102/MF A01	DE82702667	MN -80	7:61457
016/ 80	NTIS (US Sales Only), MF A0102/MF A01	DE82702659	MN -38	7:61458
018/ 80	NTIS (US Sales Only), MF A0103/MF A01	DE82702658	MN -38	7:61459
LRP-				
185/ 81	NTIS (US Sales Only), MF A0105/MF A01	DE82903479	MN -20	7:62412
LUIP-				
8203	NTIS (US Sales Only), MF A0102/MF A01	DE82702525	MN -34D	7:62278
LUNFD6/NFFK-				
70151-11(1982)	*See* LUIP-8203	DE82702525	MN -34D	7:62278
MA-				
1-81	*See* PB-82-189564			7:61712
MASEC-SCR-				
81-011	NTIS, PC A05/MF A01	DE82013429	MN -59b	7:61132

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MC-NW-				
97/ 80	NTIS, PC A02/MF A01			7:61808
METC/EGSP-				
501	NTIS, PC A03/MF A01	DE82021970	STD -92a	7:60876
MHSMP-				
82-26	NTIS, PC A02/MF A01	DE82022247	MN -45	7:61960
82-27	NTIS, PC A03/MF A01	DE82021305	MN -45	7:61961
MLM-				
2962-OP	NTIS, PC A02/MF A01	DE82019322	MN -59c	7:61148
2980	NTIS, PC A02/MF A01	DE82021998	STD -4	7:61032
2992-OP	NTIS MF A01	DE82021348	MN -22	7:61854
MPIS-				
4/ 1981	NTIS, PC A05/MF A01			7:62238
23/ 1980	NTIS, PC A06/MF A01			7:62239
MPQ-				
52	NTIS (US Sales Only), MF A0106/MF A01	DE82906233	MN -34	7:61888
N-				
82-14996	NTIS, PC A03/MF A01			7:62208
82-15913	NTIS, PC A15/MF A01			7:61889
82-16138	NTIS, PC A16/MF A01			7:61133
82-16139	NTIS, PC A16/MF A01			7:61700
82-16704	NTIS, PC A08/MF A01			7:62129
82-16877	NTIS, PC A20/MF A01			7:62413
82-16877	NTIS, PC A20/MF A01			7:62414
82-17043	NTIS, PC A25/MF A01			7:61923
82-17844	NTIS			7:62179
82-17844	NTIS			7:62180
82-17844	NTIS			7:62181
82-17844	NTIS			7:62182
82-17844	NTIS			7:62183
82-17848	Joint Publications Research Service, Arlington, VA			7:62184
NASA-CASE-MFS-				
23775-1	US Patent and Trademark Office			7:61953
NASA-CASE-NPO-				
15071-1	US Patent and Trademark Office			7:61134
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161855	*See* N-82-17043			7:61923
161959	NTIS, PC A04/MF A01			7:60807
161960	NTIS, PC A05/MF A01			7:60808
161961	NTIS, PC A04/MF A01			7:60809
163465	NTIS, PC A04/MF A01			7:61586
163470	NTIS, PC A02/MF A01			7:61076
163471	NTIS, PC A06/MF A01			7:61077
163472	NTIS, PC A07/MF A01			7:61149
163473	NTIS, PC A10/MF A01			7:61078
163474	NTIS, PC A03/MF A01			7:61079
163475	NTIS, PC A04/MF A01			7:61080
163476	NTIS, PC A11/MF A01			7:61081
165081	NTIS, PC A02/MF A01			7:61082
165098	NTIS, PC A02/MF A01			7:62226
165113	NTIS, PC A02/MF A01			7:62227
165118	NTIS, PC A03/MF A01			7:62228
165130	NTIS, PC A07/MF A01			7:61742
165175	NTIS, PC A19/MF A01			7:61743
165193	*See* DOE/NASA/0161-10	DE82019982	STD -93	7:61679
165269	NTIS, PC A15/MF A01			7:61109
165287	NTIS, PC A13/MF A01			7:61055
165328	NTIS, PC A04/MF A01			7:61680
165426	NTIS, PC A08/MF A01			7:61681
165436	NTIS, PC A04/MF A01			7:61682
165455	NTIS, PC A03/MF A01			7:61683
165536	NTIS, PC A05/MF A01			7:61748
165560	*See* DOE/NASA-0277-1	DE82021964	STD -90d	7:60746
165594	NTIS, PC A03/MF A01			7:61684
168393	NTIS, PC A08/MF A01			7:60810
168417	NTIS, PC A12/MF A01			7:61980
168429	NTIS, PC A05/MF A01			7:60811
168432	NTIS, PC A04/MF A01			7:61056
168442	NTIS, PC A02/MF A01			7:61083
168508	NTIS, PC A03/MF A01			7:62229
NASA-TM-				
58233	NTIS, PC A10/MF A01			7:61110
82751	NTIS, PC A02/MF A01			7:61228
82761	NTIS, PC A01/MF A01			7:61229
82930	*See* DOE/NASA/10350-34	DE82020329	STD -90d	7:60833
NASA-TP-				
1954	NTIS, PC A03/MF A01			7:61247
NBI-HE-				
82-8	NTIS (US Sales Only), MF A0102/MF A01	DE82702690	MN -34D	7:62299
NP-				
2902554	Dietrich Reimer Verlag, Unter den Eichen 57, 1000 Berlin 45			7:62157
2902755	Rep. - Watt Comm. Energy, No. 5, 61-68(Jun 1979)			7:61041
2902755	Rep. - Watt Comm. Energy, No. 5, 45-59(Jun 1979)			7:61043

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2902755	Watt Committee on Energy Ltd., 1 Birdcage Walk, London SW1H 9JJ England		ND -61a	7:61084
2902755	Rep. - Watt Comm. Energy, No. 5, 1-15(Jun 1979)			7:61098
2902755	Rep. - Watt Comm. Energy, No. 5, 17-24(Jun 1979)			7:61099
2902755	Rep. - Watt Comm. Energy, No. 5, 25-35(Jun 1979)			7:61100
2902755	Rep. - Watt Comm. Energy, No. 5, 37-44(Jun 1979)			7:61101
2902755	Rep. - Watt Comm. Energy, No. 5, 69-75(Jun 1979)			7:61102
2902971	NTIS (US Sales Only), MF A0106/MF A01	DE82902971	MN -88	7:60821
2903195	NTIS (US Sales Only), MF A0107/MF A01	DE82903195	MN -28	7:61924
2903385	Dietrich Reimer Verlag, Unter den Eichen 57, 1000 Berlin 45			7:62139
2903587	NTIS (US Sales Only), MF A0109/MF A01	DE82903587	MN -20	7:62487
2903645	NTIS (US Sales Only), MF A0109/MF A01	DE82903645	MN -80	7:61380
2903832	Max-Planck-Gesellschaft, Projektgruppe fuer laserforschung, D-8046 Garching bei Muenchen, Germany		ND -20	7:62488
2903868	NTIS (US Sales Only), MF A0106/MF A01	DE82903868	MN -34	7:62200
2903936	NTIS, PC A04/MF A01	DE82903936	MN -98	7:61614
2903943	NTIS (US Sales Only), MF A0102/MF A01	DE82903943	MN -41	7:61937
2903944	NTIS (US Sales Only), MF A0102/MF A01	DE82903944	MN -37	7:61938
2903984	NTIS, PC A07/MF A01	DE82903984	MN -95	7:61737
2903993	NTIS (US Sales Only), MF A0102/MF A01	DE82903993	MN -41	7:61939
2904016	NTIS, PC A04/MF A01	DE82904016	MN -90	7:60846
2904017	NTIS, PC A04/MF A01	DE82904017	MN -90	7:60847
2904063	NTIS (US Sales Only), MF A0107/MF A01		MN -38	7:61892
2904064	NTIS (US Sales Only), MF A0104/MF A01		MN -38	7:61893
2904065	NTIS (US Sales Only), MF A0105/MF A01		MN -88	7:60822
2904414	NTIS, PC A03/MF A01	DE82904414	MN -95d	7:61713
2904425	NTIS, PC A02/MF A01	DE82904425	MN -98B	7:60859
2904533	NTIS (US Sales Only), MF A0102/MF A01	DE82904533	MN -34	7:61940
2904673	NTIS, PC A02/MF A01	DE82904673	MN -70	7:60994
2905229	NTIS		MN -11	7:62054
2905970	New York Inst. of Tech., Old Westbury, NY 11568		ND -13	7:62566
2905971	GPO		MN -13	7:62541
2905974	Interstate Oil Compact Commission, P.O. Box 53127, Oklahoma City, OK 73152		MN -95	7:61649
2906001	NTIS, PC A07/MF A01	DE82906001	MN -11	7:62010
2906031	NTIS, PC A05/MF A01	DE82906031	MN -88	7:60803
2906043	NTIS, PC A03/MF A01	DE82906043	MN -88	7:60798
2906044	NTIS, PC A04/MF A01	DE82906044	MN -58	7:61135
2906068	Purdue Univ., School of Electrical Engineering, West Lafayette, IN 47907		MN -38	7:61876
2906069	NTIS, PC A03/MF A01	DE82906069	MN -70	7:62025
2906075	Wyoming Department of Labor and Statistics, Hathaway Building, Cheyenne, WY 82002		MN -51	7:60965
2906077	NTIS MF A01	DE82906077	MN -96	7:61717
2906078	NTIS, PC A03/MF A01	DE82906078	MN -96	7:61718
2906079	Wyoming Department of Labor and Statistics, Hathaway Building, Cheyenne, WY 82002		MN -88	7:60812
2906088	State of Florida Public Commission, Fletcher Building, 101 East Gaines Street, Tallahassee 32301		MN -95	7:61701
2906162	NTIS, PC A02/MF A01	DE82906162	MN -13	7:61753
2906227	Federal Emergency Management Agency, 1725 I St., NW, Washington, DC		MN -41	7:62568
NUREG-				
0020-Vol.6-No.4	NTIS- GPO		MN -80	7:61303
0090-Vol.5-No.1	GPO$4.75		MN -80	7:61364
0304-V3-SUP	NTIS, PC A03/MF A01			7:61365
0390-Vol.6-No.1	NTIS- GPO		MN -80	7:61366
0525-Rev.5	GPO$4.75		MN -80	7:61022
0528-Suppl.3	GPO$4.75		MN -78	7:61523
0580-Vol.11-No.8	GPO		MN -80	7:61367
0661-Suppl.1	GPO$3.25		MN -78	7:61524
0875	GPO$3.75		MN -78	7:61525
0881-Suppl.1	GPO$4.50		MN -78	7:61526
0887-Suppl.1	GPO$4.75		MN -78	7:61368
0892-Suppl.1	GPO$7.50		MN -78	7:61527
0936-Vol.1-No.2	GPO$7.50		MN -2	7:61369
NUREG/CP-				
0031-Vol.1	NTIS, PC A12/MF A01 - GPO $9.50		MN -80	7:61267
0031-Vol.2	NTIS, PC A12/MF A01 - GPO $9.00		MN -80	7:61278
0032	NTIS, PC A07/MF A01 - GPO $6.50		MN -80	7:61530
NUREG/CR-				
1895	GPO$4.75		MN -2	7:62011
2077	NTIS, PC A07/MF A01 - GPO		MN -80	7:61531
2238-Vol.18	NTIS, PC A12/MF A01 - GPO		MN -80	7:61532
2385	NTIS, PC A04/MF A01 - GPO		MN -78	7:61533
2409	NTIS, PC A04/MF A01 - GPO		MN -80	7:61460
2438	NTIS, PC A04/MF A01 - GPO		MN -11	7:62012
2513	NTIS, PC A04/MF A01 - GPO		MN -2	7:61534
2591	NTIS, PC A07/MF A01			7:61535
2593	NTIS, PC A04/MF A01 - GPO		MN -78	7:61536
2594	NTIS, PC A03/MF A01 - GPO		MN -78	7:61537
2646	NTIS, PC A09/MF A01 - GPO		MN -79a	7:61538
2673	NTIS, PC A04/MF A01 - GPO		MN -78	7:61539
2719	NTIS, PC A04/MF A01 - GPO		MN -80	7:61308

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2753	NTIS, PC A06/MF A01 - GPO		MN -78	7:61540
2757	NTIS, PC A04/MF A01 - GPO		MN -78	7:61309
2758	GPO$7.00		MN -80	7:61541
2763	NTIS, PC A03/MF A01 - GPO		MN -78	7:61542
2776	NTIS, PC A04/MF A01 - GPO		MN -41	7:61543
2784	GPO$6.50		MN -78	7:61544
2814-Vol.1	NTIS, PC A03/MF A01		MN -80	7:61545
2833-Vol.1	GPO$5.00		MN -80	7:61370
2833-Vol.2	GPO$9.50		MN -80	7:61371
2833-Vol.3	GPO$8.00		MN -80	7:61372
2834	NTIS, PC A08/MF A01 - GPO $6.50		MN -78	7:61327
2859	NTIS, PC A06/MF A01 - GPO		MN -41	7:62049
2868	NTIS, PC A03/MF A01 - GPO		MN -80	7:61461
NVO-				
247	NTIS, PC A07/MF A01	DE82022540	STD -70	7:60995
NYSERDA-				
81-25	NTIS, PC A04/MF A01	DE82905983	MN -13	7:60836
82-21	NTIS, PC A05/MF A01	DE82021590	MN -95d	7:61702
OEFZS-				
4048	NTIS (US Sales Only), MF A0102/MF A01	DE82702466	MN -48	7:62130
4105	NTIS (US Sales Only), MF A0103/MF A01	DE82702691	MN -34A	7:62240
OFR-				
82-4-SAC	*See* DOE/SF/10855-82-4	DE82022220	MN -66a	7:61160
155-NM	*See* DOE/NBM-2021060	DE82021060	MN -51	7:60914
ONWI-				
106	NTIS, PC A08/MF A01	DE82015755	MN -70	7:60996
324	NTIS, PC A08/MF A01	DE82021541	MN -70	7:61809
ORAU/IEA-				
82-6(M)	NTIS, PC A03/MF A01	DE82021950	MN -13	7:61993
ORNL-				
5886	*See* NUREG/CR-2753		MN -78	7:61540
5908	NTIS, PC A05/MF A01	DE82021113	MN -32	7:62567
ORNL/MIT-				
344	NTIS, PC A05/MF A01	DE82016602	MN -90d	7:60769
352	NTIS, PC A04/MF A01	DE82021107	MN -90d	7:60754
ORNL/TM-				
8111	NTIS, PC A02/MF A01	DE82021110	MN -77	7:61475
8146	NTIS, PC A04/MF A01	DE82021111	MN -90c	7:61248
8160	NTIS, PC A07/MF A01	DE82021090	MN -90d	7:60755
8185	NTIS, PC A10/MF A01	DE32021092	MN -79d	7:61426
8193	NTIS, PC A03/MF A01	DE82016616	STD -20g	7:62415
8206	NTIS, PC A03/MF A01	DE82021116	STD -20	7:62416
8215	NTIS, PC A02/MF A01	DE82021112	MN -90b	7:60799
8226	NTIS, PC A03/MF A01	DE82016578	STD -77	7:61375
8278	*See* NUREG/CR-2719		MN -80	7:61308
8283	NTIS, PC A04/MF A01	DE82021115	STD -79d	7:61349
8285	NTIS, PC A05/MF A01	DE82021114	MN -34C	7:62316
8306	*See* NUREG/CR-2673		MN -78	7:61539
8349	NTIS, PC A02/MF A01	DE82016581	MN -80	7:61495
8362	NTIS, PC A05/MF A01	DE82021091	STD -79d	7:61350
8363	NTIS, PC A02/MF A01	DE82020474	MN -48	7:61871
8366	NTIS, PC A05/MF A01	DE82021108	MN -95d	7:61703
8427	NTIS PCE04/MF A01	DE82021181	MN -90c	7:60756
8435	NTIS, PC A03/MF A01	DE82021106	MN -86	7:60954
ORNL-tr-				
4861	NTIS, PC A02/MF A01	DE82020335	MN -48	7:62043
4864	NTIS, PC A04/MF A01	DE82021912	MN -80	7:61441
4871	NTIS, PC A02/MF A01	DE82021020	MN -25	7:61781
4873	NTIS, PC A02/MF A01	DE82021017	MN -25	7:61780
ORO-				
1797-99	*See* DOE/ER/01797-99	DE82021932	MN -4	7:61868
3346-250	*See* DOE/ER/03346-250	DE82021939	MN -34C	7:62327
3509-18	*See* DOE/ER/03509-18	DE82021935	MN -34D	7:62273
OUP-				
81-21	NTIS (US Sales Only), MF A0103/MF A01	DE82702616	MN -34D	7:62291
P-				
500-82-005	NTIS, PC A04/MF A01	DE82905758	MN -95d	7:61630
700-82-005	NTIS MF A01	DE82905249	MN -66a	7:61187
PATENTS-US-	(US: Commissioner of Patents, Washington, D.C. 20231, USA, $1.00 per copy. Government Patent Applications available from NTIS)			
A 322,145		DE82020869		7:61903
A 326,775		DE82020843		7:61844
A 326,972				7:61153
PB-				
82-181769	NTIS, PC A04/MF A01			7:61733
82-185091	NTIS, PC A04/MF A01			7:62040
82-185240	NTIS, PC A10/MF A01			7:61496
82-185430	NTIS, PC A07/MF A01			7:61200
82-186453	NTIS, PC A02/MF A01			7:61704
82-187071	NTIS, PC A99/MF A01			7:60861
82-187139	NTIS, PC A15/MF A01			7:60813
82-188517	NTIS, PC A03/MF A01			7:61719
82-188566	NTIS, PC A03/MF A01			7:62417
82-189077	NTIS, PC A02/MF A01			7:61136

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82-189515	NTIS, PC A03/MF A01			7:60800
82-189556	NTIS, PC A05/MF A01			7:61994
82-189564	NTIS, PC A14/MF A01			7:61712
82-189614	NTIS, PC A04/MF A01			7:61995
82-189705	NTIS, PC A02/MF A01			7:60842
82-189770	NTIS, PC A02/MF A01			7:62185
82-190067	NTIS, PC A02/MF A01			7:61996
82-190158	NTIS, PC A11/MF A01			7:62050
82-190166	NTIS, PC A11/MF A01			7:62051
82-190331	NTIS, PC A02/MF A01			7:61137
82-190398	NTIS, PC A99/MF A01			7:62045
82-190406	NTIS, PC A99/MF E01			7:62046
82-190414	NTIS, PC A99/MF A01			7:62047
82-191180	NTIS, PC A02/MF A01			7:60795
82-191701	Source tape is in EBCDIC character set. Tapes can be prepared in most standard 7 or 9 track recording modes for one-half inch tape. Identify recording mode desired by specifying character set, track, density, and parity. Call NTIS Computer Products if you have questions. Price includes documentation, PB82-191693.			7:60814
82-192295	NTIS, PC A03/MF A01			7:60862
82-192303	NTIS, PC A99/MF A01			7:60863
82-193046	NTIS, PC A03/MF A01			7:60864
82-193566	NTIS, PC A02/MF A01			7:60843
82-196924	NTIS, PC A07/MF A01			7:61905
82-199035	NTIS, PC A09/MF A01			7:61752
82-200627	NTIS, PC A03/MF A01			7:61858
82-201773	NTIS, PC A03/MF A01			7:61997
82-202490	NTIS, PC A04/MF A01			7:61597
82-202573	NTIS, PC A24/MF A01			7:61906
82-202581	NTIS, PC A15/MF A01			7:62015
82-202748	NTIS, PC A04/MF A01			7:60815
82-203209	NTIS, PC A99/MF A01			7:61907
82-203662	NTIS, PC A03/MF A01			7:61705
82-204082	NTIS, PC A06/MF A01			7:62038
82-204322	NTIS, PC A06/MF A01			7:61546
82-204678	NTIS, PC A04/MF A01			7:61547
82-205725	NTIS, PC A06/MF A01			7:60816
82-206368	NTIS, PC A03/MF A01			7:61998
82-206830	NTIS, PC A03/MF A01			7:61548
82-207630	NTIS, PC A03/MF A01			7:61738
82-208299	NTIS, PC A04/MF A01			7:60826
82-208455	NTIS, PC A04/MF A01			7:60854
82-208570	NTIS, PC A02/MF A01			7:62286
82-210089	NTIS, PC A17/MF A01			7:60796
82-214321	NTIS, PC A05/MF A01			7:60878
PFC/RR-				
82-16	*See* DOE/ET/51013-46	DE82015605	STD -20b	7:62471
PGJ/F-				
043-82	NTIS PCE08/MF $4.20	DE82021860	MN -51	7:60940
088(82)	NTIS PCE05/MF A01	DE82020960	MN -51	7:60941
089-82	NTIS PCE08/MF $8.60	DE82021858	MN -51	7:60942
090-82	NTIS PCE05/MF $4.20	DE82020957	MN -51	7:60943
091-82	NTIS PCE03/MF A01	DE82019839	MN -51	7:60944
092-82	NTIS PCE08/MF A01	DE82020958	MN -51	7:60945
094-82	NTIS PCE09/MF $8.40	DE82021859	MN -51	7:60946
098-82	NTIS PCE04/MF A01	DE82020587	MN -51	7:60947
101-82	NTIS PCE05/MF $4.20	DE82021650	MN -51	7:60948
105-82	NTIS PCE09/MF $8.40	DE82021656	MN -51	7:60949
111-82	NTIS PCE10/MF A01	DE82021652	MN -51	7:60950
PH-				
326/ 81	*See* OEFZS-4105	DE82702691	MN -34A	7:62240
PM-				
80-4	NTIS, PC A02/MF A01			7:61230
81/ 7	NTIS (US Sales Only), MF A0103/MF A01	DE82903592	MN -34	7:62303
PNL-				
3696	*See* NUREG/CR-1895		MN -2	7:62011
3858	NTIS, PC A03/MF A01	DE82022518	MN -11	7:62022
3890	NTIS, PC A03/MF A01	DE82021377	MN -60	7:61209
4029	NTIS, PC A03/MF A01	DE82021122	MN -70	7:60997
4043	NTIS, PC A07/MF A01	DE83000397	MN -12	7:61249
4266	NTIS, PC A04/MF A01	DE82021361	MN -70	7:61767
4329	NTIS, PC A03/MF A01	DE83000383	MN -95a	7:61706
4389	NTIS, PC A03/MF A01	DE83000400	MN -70	7:60998
4408	*See* DOE/UMT-0211	DE82022037	MN -70A	7:60983
PPPL-				
1921	NTIS, PC A02/MF A01	DE82022233	STD -20f	7:62489
1927	NTIS, PC A03/MF A01	DE82022226	STD -20f	7:62490
1929	NTIS, PC A04/MF A01	DE82022232	STD -20a	7:62491
1930	NTIS, PC A04/MF A01	DE82022231	STD -20g	7:62418
PPPL-Q-				
39	NTIS, PC A05/MF A01	DE82022158	STD -20	7:62492
PRI-				
50	*See* SAI-254-82-244-LJ	DE82022155	STD -20g	7:62420

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PTB-FMRB-				
81	NTIS (US Sales Only), MF A0103/MF A01	DE82903548	MN -80	7:62550
RDA-TR-				
118700-004	NTIS, PC A02/MF A01	DE82019168	MN -96	7:61745
REPT-				
81-131	NTIS, PC A03/MF A01			7:62493
658	AN SSSR, Moscow			7:62230
RFP-				
3282	NTIS, PC A02/MF A01	DE83000027	STD -70	7:60999
3291	NTIS, PC A04/MF A01	DE82015122	STD -60	7:61231
3301	NTIS, PC A08/MF A01	DE82021711	STD -60	7:61232
3305	NTIS, PC A06/MF A01	DE82015400	STD -60	7:61213
3324	NTIS, PC A05/MF A01	DE82021952	STD -4	7:60955
3331/ 1	NTIS, PC A02/MF A01	DE82021709	STD -60	7:61233
3331/ 2	NTIS, PC A09/MF A01	DE82021710	STD -60	7:61234
3339	NTIS, PC A09/MF A01	DE82016358	STD -60	7:61235
3359	NTIS, PC A02/MF A01	DE82021618	MN -10	7:61835
RFP-Trans-				
328	NTIS, PC A03/MF A01	DE82021720	MN -11	7:61908
RHO-BW-SA-				
190	NTIS, PC A02/MF A01	DE82015795	MN -70	7:61000
201-P	NTIS, PC A02/MF A01	DE82021718	MN -70	7:62196
RHO-BWI-C-				
116-Vol.1	NTIS, PC A15/MF A01	DE82022063	MN -70	7:61001
116-Vol.2	NTIS, PC A07/MF A01	DE82021389	MN -70	7:61002
Rijnhuizen-				
81-138	NTIS (US Sales Only), MF A0104/MF A01	DE82702699	MN -20	7:62419
RLO-				
2225-T18-22	NTIS MF A01	DE82021989	MN -11	7:62041
RR-				
55	*See* PB-82-200627			7:61858
151-Pt-1	NTIS, PC A03/MF A01			7:60817
152-Pt-2	NTIS, PC A02/MF A01			7:60818
SAAS-				
285	NTIS (US Sales Only), MF A0102/MF A01	DE82702479	MN -78	7:61334
287	NTIS (US Sales Only), MF A0105/MF A01	DE82702485	MN -37	7:61941
SAI-				
254-82-244-LJ	NTIS, PC A02/MF A01	DE82022155	STD -20g	7:62420
SAND-				
81-0100	NTIS, PC A06/MF A01	DE82021128	STD -66	7:61197
81-1529-Vol.18	*See* NUREG/CR-2238-Vol.18		MN -80	7:61532
81-2122	NTIS, PC A03/MF A01	DE82021296	STD -91	7:60886
81-2216	*See* NUREG/CR-2385		MN -78	7:61533
81-7019(Vol.2)	NTIS, PC A12/MF A01	DE82015626	MN -63a	7:61111
81-7038	NTIS, PC A05/MF A01	DE82016377	MN -62	7:61150
81-7080/ 1	NTIS, PC A04/MF A01	DE83000393	MN -63d	7:61112
81-7085/ 12	NTIS, PC A03/MF A01	DE83000391	MN -63d	7:61113
81-7089/ 3	NTIS, PC A02/MF A01	DE82020883	MN -63d	7:61114
81-7168	*See* NUREG/CR-2409		MN -80	7:61460
81-7194	NTIS, PC A03/MF A01	DE82016179	MN -63c	7:61085
81-7209	NTIS, PC A03/MF A01	DE82019876	STD -70	7:61003
82-0181	NTIS, PC A07/MF A01	DE82022224	MN -62	7:61117
82-0341	NTIS, PC A04/MF A01	DE82020053	STD -90h	7:60757
82-0383C	NTIS, PC A02/MF A01	DE82021870	MN -78	7:61549
82-0441C	NTIS, PC A02/MF A01	DE82022005	MN -78	7:61550
82-0450C	NTIS, PC A02/MF A01	DE82022004	MN -78	7:61551
82-0485	*See* NUREG/CR-2868		MN -80	7:61461
82-0547	NTIS, PC A04/MF A01	DE82022239	MN -70	7:61004
82-0624	*See* NUREG/CR-2758		MN -80	7:61541
82-0678	NTIS, PC A03/MF A01	DE82022235	MN -92	7:62197
82-0765	*See* NUREG/CR-2646		MN -79a	7:61538
82-0773C	NTIS, PC A03/MF A01	DE82021871	MN -25	7:61796
82-0780C	NTIS, PC A03/MF A01	DE82020982	MN -25	7:61810
82-0787C	NTIS, PC A02/MF A01	DE82020407	MN -34	7:61811
82-0819	NTIS, PC A02/MF A01	DE82022238	MN -71	7:60962
82-0943C	NTIS, PC A02/MF A01	DE82020055	MN -48	7:62092
82-1071	*See* NUREG/CR-2763		MN -78	7:61542
82-1173	NTIS, PC A03/MF A01	DE82022153	MN -78	7:61328
82-1176	NTIS, PC A06/MF A01	DE82022234	MN -70	7:61005
82-1191	NTIS, PC A04/MF A01	DE82022240	MN -90i	7:60797
82-1200	NTIS, PC A04/MF A01	DE82018329	STD -71	7:60963
82-1260C	NTIS, PC A02/MF A01	DE82021724	MN -78	7:61552
82-1291C	NTIS, PC A03/MF A01	DE82019341	MN -38	7:61894
82-1586C	NTIS, PC A02/MF A01	DE82018645	MN -21	7:62494
82-1783	NTIS, PC A05/MF A01	DE82022241	MN -70	7:61006
82-1812C	NTIS, PC A02/MF A01	DE82020290	MN -78	7:61553
82-1816C	NTIS, PC A03/MF A01	DE82019485	MN -45	7:61962
82-1909C	NTIS, PC A02/MF A01	DE82020355	MN -32	7:62551
82-1923C	NTIS, PC A02/MF A01	DE82020441	MN -80	7:61554
82-7013	*See* NUREG/CR-2593		MN -78	7:61536
82-7014	*See* NUREG/CR-2594		MN -78	7:61537
82-7041	NTIS, PC A04/MF A01	DE82016379	MN -92a	7:60850
82-7050	NTIS, PC A05/MF A01	DE82022151	MN -94c	7:61598
82-7055	NTIS, PC A05/MF A01	DE82021127	STD -66	7:61198
82-8227	NTIS, PC A03/MF A01	DE82019996	MN -11	7:61873

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82-8235	NTIS, PC A03/MF A01	DE82021074	MN -13	7:61250
82-8668	NTIS, PC A02/MF A01	DE82015879	MN -25	7:61768
82-8817	NTIS, PC A02/MF A01	DE82021705	MN -90e	7:60837
SCPRI-RT-				
3-1981	NTIS (US Sales Only), PC A	DE82903176	MN -41	7:62023
4-1981	NTIS (US Sales Only), PC A	DE82903185	MN -41	7:62024
SERI/PR-				
1202-1-T5	NTIS, PC A06/MF A01	DE82019282	MN -63e	7:61086
9100-1-T2	NTIS, PC A03/MF A01	DE82008026	MN -63	7:61087
9330-1-T5	NTIS, PC A02/MF A01	DE82011043	MN -63	7:61088
SERI/SP-				
19136-4	NTIS, PC A05/MF A01	DE82021014	MN -60	7:61236
SERI/TP-				
213-1618	NTIS, PC A02/MF A01	DE82020507	MN -63b	7:61089
234-1681	NTIS, PC A02/MF A01	DE82020069	MN -62	7:61090
252-1685	NTIS, PC A02/MF A01	DE82020981	MN -62	7:61156
252-1691	NTIS, PC A02/MF A01	DE82020989	MN -62	7:61157
254-1652	NTIS, PC A02/MF A01	DE82019255	MN -59c	7:61707
254-1653	NTIS MF A01	DE82018194	MN -59c	7:61047
254-1673	NTIS, PC A02/MF A01	DE82022038	MN -59a	7:61708
SERI/TR-				
214-1449	NTIS, PC A05/MF A01	DE82021997	MN -62c	7:61118
215-1519	NTIS, PC A04/MF A01	DE82022229	MN -63a	7:61048
252-1438	NTIS, PC A03/MF A01	DE82021360	MN -62	7:61138
255-1432	NTIS, PC A02/MF A01	DE82021359	MN -62	7:61151
631-1062	NTIS, PC A04/MF A01	DE82022036	MN -62	7:61152
642-1149	NTIS, PC A03/MF A01	DE83000504	MN -59	7:61049
09275-2	NTIS, PC A05/MF A01	DE82016380	MN -60	7:61057
09380-1	NTIS, PC A10/MF A01	DE82022031	MN -61a	7:61091
SERP-E-				
112	*See* IFVE-OEF-81-93	DE82702617	MN -34D	7:62282
SOLAR/0010-				
82/ 08	NTIS, PC A06/MF A01	DE83000066	MN -59	7:61050
SOLAR/0024-				
82/ 41	NTIS, PC A10/MF A01	DE83000069	STD -59	7:61139
SOLAR/1060-				
82/ 14	NTIS, PC A05/MF A01	DE82016999	STD -59	7:61140
SOLAR/1096-				
82/ 14	NTIS, PC A05/MF A01	DE83000065	STD -59	7:61141
SOLAR/1106-				
82/ 14	NTIS, PC A06/MF A01	DE83000067	STD -59	7:61142
SOLAR/1107-				
82/ 14	*See* SOLAR/1106-82/14	DE83000067	STD -59	7:61142
SOLAR/1110-				
82/ 14	*See* SOLAR/1106-82/14	DE83000067	STD -59	7:61142
SOLAR/2116-				
82/ 14	NTIS, PC A05/MF A01	DE83000068	STD -59	7:61143
SRI-PYU-				
3341	Federal Emergency Management Agency, 1725 I Street, N.W., Washington, DC 20472		MN -41	7:61963
STI/PUB-				
608	UNIPUB, 345 Park Ave., South, New York, NY 10010		ND -48	7:62083
TTC-				
0298	*See* SAND-82-0819	DE82022238	MN -71	7:60962
TTI-				
2-8-77-225-24	*See* FHWA/TX-82/24-225-24	DE82906165	MN -96	7:61715
TVA-				
2903917	NTIS, PC A05/MF A01	DE82903917	MN -2	7:61637
2905135	NTIS, PC A02/MF A01	DE82905135	MN -41	7:62131
TVA/OACD-				
82/ 16	NTIS, PC A02/MF A01	DE82906065	MN -61a	7:61092
TVA/ONR/WR-				
82/ 9	NTIS, PC A06/MF A01	DE82905980	MN -88	7:60819
UCID-				
16986-82-2	NTIS, PC A02/MF A01	DE83000503	MN -91	7:60887
19347	NTIS, PC A04/MF A01	DE82016085	MN -32	7:62552
19417	NTIS, PC A03/MF A01	DE82021947	MN -38	7:61896
19422	NTIS, PC A03/MF A01	DE82021120	MN -20	7:62421
19444	NTIS, PC A02/MF A01	DE83000654	STD -20	7:62495
19447	NTIS, PC A02/MF A01	DE82019263	MN -25	7:61804
19460	NTIS, PC A02/MF A01	DE82021013	MN -97b	7:61265
19493	NTIS, PC A03/MF A01	DE82021686	MN -11	7:61967
19500	NTIS, PC A03/MF A01	DE82022516	MN -58	7:61093
19542	NTIS, PC A03/MF A01	DE82022035	MN -37	7:61954
19543	NTIS, PC A02/MF A01	DE82021358	MN -35	7:61966
19544	NTIS, PC A02/MF A01	DE82022517	MN -32	7:62553
19546	NTIS, PC A02/MF A01	DE82021012	MN -34	7:62264
19547	NTIS, PC A02/MF A01	DE82021011	MN -91	7:60889
19549	NTIS, PC A03/MF A01	DE82022034	MN -32	7:62317
19551	NTIS, PC A02/MF A01	DE82021009	MN -32	7:62554
19565	NTIS, PC A02/MF A01	DE83000745	MN -34	7:62380
19567	NTIS, PC A03/MF A01	DE83000655	MN -34C	7:61942
30194	NTIS, PC A03/MF A01	DE82021008	MN -32	7:62555
UCLA-ENG-				
81-48	*See* AD-A-112377/7			7:62391

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UCRL-				
15477	NTIS MF A01	DE82019104	MN -38	7:62496
15479	NTIS, PC A03/MF A01	DE82020175	MN -94cb	7:61599
15487	NTIS, PC A03/MF A01	DE82021384	MN -94b	7:61897
53026	*See* NUREG/CR-2077		MN -80	7:61531
53037	*See* NUREG/CR-2513		MN -2	7:61534
53310	NTIS, PC A05/MF A01	DE82022033	MN -34	7:62556
85833	NTIS, PC A03/MF A01	DE82019109	MN -38	7:61879
86113	NTIS, PC A03/MF A01	DE82019114	MN -21	7:61025
86218	NTIS, PC A02/MF A01	DE82016778	MN -15	7:61023
86739	NTIS, PC A03/MF A01	DE82012701	MN -38	7:61880
86827	NTIS, PC A02/MF A01	DE82015909	MN -32	7:62497
86910	NTIS, PC A02/MF A01	DE82020177	MN -21	7:62498
87059	NTIS, PC A03/MF A01	DE82020170	MN -21	7:62499
87158	NTIS, PC A03/MF A01	DE82020848	MN -21	7:62500
87248	NTIS, PC A02/MF A01	DE82021351	MN -85	7:61007
87347	NTIS, PC A02/MF A01	DE82019240	MN -20a	7:62501
87400	NTIS, PC A02/MF A01	DE82020965	MN -38	7:62372
87414	NTIS, PC A02/MF A01	DE82012260	MN -32	7:62557
87473	NTIS, PC A02/MF A01	DE82015192	MN -32	7:62558
87532	NTIS, PC A02/MF A01	DE82021616	MN -21	7:62502
87553	NTIS, PC A02/MF A01	DE82020378	MN -11	7:61999
87601	NTIS, PC A02/MF A01	DE82021927	MN -25	7:61802
87612	NTIS, PC A02/MF A01	DE82020344	MN -32	7:62559
87639	NTIS, PC A03/MF A01	DE82016841	MN -38	7:61898
87668	NTIS, PC A02/MF A01	DE82015922	MN -11	7:60879
87675	NTIS, PC A02/MF A01	DE82021117	MN -20f	7:62422
87706	NTIS, PC A02/MF A01	DE82016252	MN -20d	7:61026
87735	NTIS, PC A02/MF A01	DE82020728	MN -20	7:62503
87759	NTIS, PC A02/MF A01	DE82019107	MN -32	7:62560
87785	NTIS, PC A02/MF A01	DE82019317	MN -11	7:62193
87815	NTIS, PC A03/MF A01	DE82019063	MN -34B	7:62209
87948	NTIS, PC A02/MF A01	DE82020352	MN -20b	7:62423
87948-Rev.1	NTIS, PC A02/MF A01	DE82020850	MN -20g	7:62424
UFRJ-COPPE-PEN-				
103	NTIS (US Sales Only), MF A0103/MF A01	DE82702669	MN -78	7:61555
USGS-				
474-314	NTIS, PC A02/MF A01	DE82021613	MN -11	7:62187
USGS-OFR-				
80-1290	Geological Survey, Open File Service, Denver Federal Center, Box 25425, Denver, CO 80225		MN -66a	7:61161
81-134	USGS - Open File Service, Box 25425 - Denver Federal Center, Denver, CO 80225		MN -66a	7:61163
81-556	NTIS, PC A02/MF A01	DE82021830	MN -51	7:62561
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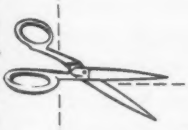

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